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Blast Furnace and Foundry

Never has the link between pig-iron manufacture and foundry practice been established in such an interesting manner as has been done by Mr. N. L. Evans in a Paper which is printed elsewhere in this issue. The technique of the desulphurisation of cast iron by soda ash was developed initially by the British ironfoundry industry, and the methods adopted have been utilised by the ironmasters as an essential part of the eminently successful acid-burden process of pig-iron manufacture. The foundry industry recognises and appreciates the material help given to it by the author and his colleagues in the Technical Service Division of the I.C.I.

When the soda-ash process became the subject of experiment by the great ironworks, with their much greater research resources, it was to be expected that the results would in their turn be of value to the foundryman. Little did we expect that one outcome would be the confirmation (or was it anticipation?) of the results obtained by Levy. It is but a few weeks ago since we deemed it expedient to comment editorially on Levy's researches, which showed that the judicious use of soda ash could, and did, induce enhanced fluidity in the metal so treated. The experiments which Mr. Evans described as having been carried out in a French works showed that the temperature of the treated iron entering the basic Bessemer was 20 deg. higher than the untreated metal, whilst a new form of fluidity test more than confirmed the results to be expected from so considerable a temperature rise. It now seems certain that the endothermic soda-ash reaction is more than counterbalanced by the exothermic desiliconising reaction. This result should give hope and encouragement to the light-castings foundries in their search for a better base iron, the surface of which is subsequently to be vitreous enamelled.

The acid-burden process of pig-iron manufacture is not without direct interest to the foundries, for apart from the obvious economic advantages resulting from the increased utilisation of domestic iron-ore supplies, the materially increased hourly yield of pig-iron would tend to ameliorate restrictive measures on the consumption of pig-iron. Looking further ahead, the foundry industry can anticipate abundant supplies of a cheap raw material.

One line of experiment which is being pursued, and which shows every promise of ultimate success, is the use of basic or dolomite linings to the ladles set aside for desulphurising. In this connection, we counsel the initial avoidance of improvisation for the preparation of the tar-bonded dolomite. Our extensive personal experience has dictated that the following steps are essential if trouble is to be avoided: The crushed dead burnt dolomite as received by the foundry should be heated to between 300 and 400 deg. C. in a simple furnace specially built for the purpose and located near a light-rollered pug mill. The tar must also be well heated to free it from moisture. The dolomite is charged into the mill whilst still hot, and as soon as rotation has spread the material, a minimum quantity of tar, just sufficient to blacken the whole of the mixture, is added. Without losing any time, the hot mixture is rammed between the templets and the ladle casing. This method utilises a minimum of tar and yields a lining, after burning out, of a much more durable character, showing a decreased tendency to hydrate when standing cold over week-ends. We assert that, luck apart, dolomite and tar cannot be properly prepared by shovel-mixing on a steel sheet supported on four bricks, and heated from beneath by a coal fire. The fumes alone are sufficient to impair workmanship.

Finally, it is useless to deny that there have been prejudices in high quarters against the acid-burden process, but these are fast being dissipated by the practical results achieved, and we hope that the breadth of vision which has ever animated the leaders of thought in British business will again show itself as related to a major factor in ensuring the stability of an iron industry based entirely upon domestic resources. The assumption that steel scrap will invariably be cheaper than pig-iron is no longer a sure basis for metallurgical invention, as has been the case for the last forty years, and the type of work dealt with by Mr. Evans represents a better line of approach to the metallurgical future.

Book Reviews

The Geometry of Sheet Metal Work. By A. Dickason. Published by Sir Isaac Pitman & Sons, Limited, Parker Street, Kingsway, London, W.C.2. Price 12s. 6d. net.

This book is destined to rank for all time as a standard treatise on the subject covered, for the geometry of sheet metal work is a science, to which the future can bring no fresh knowledge. This being so, the worth of the book must be judged by the arrangement of the matter, the suitability of examples quoted and the clarity of the illustrations. The author, being a technical college lecturer, whilst holding an appointment in a very large manufacturing concern, has been able so to arrange the contents as to cover five school courses, whilst drawing upon his profound industrial knowledge for the application of theory to practice. For the first three courses, covered in ten chapters, the system of referring in sequence to the methods of radial lines, parallel lines and triangulation has been pursued. This arrangement, when augmented by the presentation of similar groups of problems, ensures the logical and progressive study of the principles of pattern drafting. By the time the fourth and fifth courses are reached really difficult and advanced problems are efficiently dealt with.

Illustration in a book of this character assumes an importance of equal force to the letterpress, and the 233 line drawings used are the essence of clarity. Considering the book cannot become out of date, the price charged, judged by modern standards, is very reasonable.

V.C.F.

Mechanical World Year Book, 1941 Edition. Published by Emmott & Company, Limited, 31, King Street West, Manchester, 3. Price 2s. net.

The main feature amongst the modifications to this well-known and generally appreciated handbook is the incorporation of new sets of tables for the better-known ball and roller bearings. A new section on case hardening has been incorporated. There are quite a number of tables and paragraphs of interest to foundry foremen.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Cast-Iron Armaments

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The editorial article in the November issue of your American contemporary, "The Foundry," includes this sentence: "Both regular and educational orders for shell and ammunition parts are being cast in grey iron for both British and American Governments."

We are surprised to read this, as we are under the impression that a good many grey-iron foundries in England are not fully occupied. We realise that many factors are involved about which we can know nothing, but it seems curious that American exchange should be used in buying iron castings, unless our own productive capacity is fully employed already.—Yours, etc.,

R. STOREY
(Director, The Storey Foundry Company, Limited).

Sheffield Street,
Heaton Norris, Stockport.

TANGYES, LIMITED, Birmingham, announce that their London offices are temporarily at 28, Budge Row, E.C.4.

Premiums for Workmen's Compensation

BY F. J. TEBBUTT

Where the Workmen's Compensation Acts differ from the other schemes of Government social legislation (Unemployment, Health and Pensions) is that, unlike those schemes under which the liability of the employer ends with the payment of contributions, with workmen's compensation there is always the possibility of the employer being called upon to make compensation payments, if an employee sustains an injury (by accident or industrial disease) arising out of and in the course of the employment.

Compensation may be by weekly payments while the disability lasts, and may be anything up to 35s. weekly (increased from 30s. weekly by a 1940 Act) or up to £600 payable to dependants if death results. Furthermore the W.C. (Supplementary Allowances) Act, 1940, provides also for weekly payments, where there are children under 15 years, of 4s. weekly for each of the first two children and 3s. for any other child.

Although there is no Government insurance scheme as shown, insurance can be effected with ordinary insurance companies, and it is important to note that there is an arrangement between the Home Office and the Accident Offices Association (of which most companies are members) whereby the premiums payable are adjusted each year up or down.

Under this arrangement, accounts are prepared up to December 31 each year, and the adjustment in premiums operates on premiums falling due after the following June 30. The accounts give on one side (premiums) the amounts received for premiums, etc., and on the other side (losses) the amount paid in compensation or set aside. The percentage of the losses to the premiums, called the "loss ratio," is ascertained, and this operates for the adjustment against a basic "loss ratio" laid down in the Home Office arrangement.

The basic "loss ratio" to operate for the year ending December 31, 1939, is 62.5 per cent., and the actual "loss ratio" arising from these accounts has worked out at 59.77 per cent.; therefore, on premiums falling due up to June 30, 1941, employers will receive a rebate of 2.73 per cent., the difference between the actual 59.77 per cent. and the basic "loss ratio" of 62.5 per cent. The balance sheet shows £6,250,076 on the premiums side, £3,735,453 on the "losses" side, a "loss ratio" of 59.77 per cent. It might be of interest to note that, since 1924, rebates have been declared varying from 2.16 per cent. to 14.32 per cent.

The new Act of 1940 mentioned, which provides for increases in payments as shown, has necessitated alterations in the Home Office arrangement, but the Accident Offices Association has undertaken that, where any company concerned is liable to make a weekly payment in respect of any pre-August 19, 1940, accident, the company itself will meet the extra payment without calling upon the employer for additional payments. As a set-off for this, the Home Office has agreed to increases being made in the amount included in the "losses" side of the balance sheet for reserves, for claims outstanding. Another point to be noted is that, for accounts for the year ending December 31, 1940, which will determine the rise or fall in premiums from July 1, 1941, the basic "loss ratio" is to be 65 per cent., instead of 62½ per cent. as formerly.

"I don't seem to get the nick of knittin' on all fours!" announced Mrs. Malaprop, as she handed in a home knitted scarf at the W.V.S. depot. "MARKSMAN."

Random Shots

A correspondent from Scotland thinks that the following gem from an Official Brain should not be hidden for ever in dusty archives; and quite right, too! For in these serious and strained days a smile, no matter at whose expense, is good for the soul. The Ministry of Labour and National Service requires to know the exact nature of the duties of a certain moulder. The managing director of the foundry in which he works is therefore asked to indicate which class of work the man normally follows opposite the details below:—"Makes moulds, generally of loam, a mixture of clay, sand and chopped straw for casting large, circular, or partly circular objects; builds up foundation on special plate or floor of casting pit, and then, with the aid of templates fixed to a spindle and otherwise, builds up outer mould or 'cope'; builds up cores in similar way; faces both cope and cores with plastic loam, and smoothes off with trowels and scrapers to coincide with templates supplied; fixes plate on top of mould when finished and clamps upper and lower plates together." Or "able to make moulds in sand or loam by different processes, or has specialised in making moulds for particular articles which are to be cast in iron; if cores are required, moulder places 'core prints' in sand with pattern subsequently replacing them by cores."

* * *

"Marksman" cannot help feeling that this description of the duties of a loam moulder had better be kept from the apprentices lest they take fright and join the fighting services.

* * *

Those parcipitants in the Foundry Congress held in London in 1939 who visited the Barbers' Hall so kindly thrown open by the Worshipful Company of Surgeon-Barbers will be grieved to hear that it has been demolished by enemy action during the night of the London Fires. It will be remembered that on that occasion no little disappointment was felt that so many of the most highly treasured possessions of that Company were not on view, having already been sent to a place of greater safety. That disappointment is now changed to a feeling of thankfulness for such foresight, and a hope that all lovers of London's historical treasures may yet have a chance to see them at some future date.

* * *

From roundabout sources it is learnt that new low-value stamps of France are to bear the picture of Marshal Pétain. Is it then a sign of a reviving spirit in France that the higher values are left free . . . for the picture, perhaps, of General de Gaulle?

* * *

Every Rose has its Thorn . . .

Overheard at home one morning shortly after Christmas, where the children are chewing much pen-holder over "thank you" letters.

Mary to John: "How *do* you spell 'beautiful'?"

No answer.

Mary (louder): "Hi, you mutt, how do you spell 'beautiful'?"

No answer.

Mary (giving it up with a sigh): "Oh, never mind. I'll just say 'Thank you for your present.' It's quite enough for one mingy handkerchief, anyhow."

Mary (a little later): "Oh, John, how do you spell 'uv'?"

John: "There isn't such a word, silly!"

Mary: "There must be; you know, I want to say 'You should 'uv seen Father pretending to be Father Christmas.'"

(Continued at foot of previous column.)

Recent European Developments in Pig-Iron Manufacture*

THEIR RELATION TO PRESENT BRITISH PRACTICE

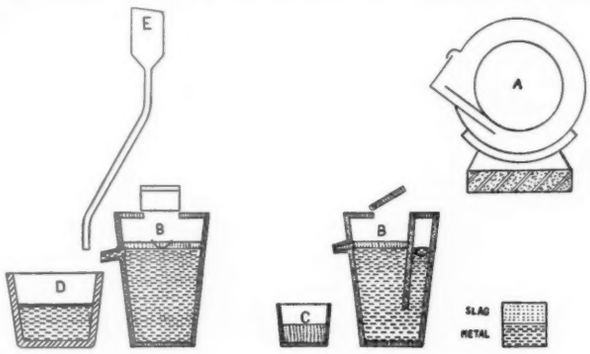
By N. L. EVANS, B.Sc., A.I.C.

Prior to the outbreak of the present war, certain new developments connected with pig-iron production were being investigated on the continent of Europe, and as they are related to problems now arising in Great Britain, it is felt that the following account of some of the developments which took place may be of value to the iron industry in this country.

The difficulties which were encountered in England in the early 1930's, when the low-grade aluminous iron-ore deposits of Northamptonshire were being developed for basic steelmaking, were first overcome by the processes introduced by H. A. Brassert & Company, Limited, in the plant built at Corby for Stewarts and Lloyds, Limited, and were also being investigated by Paschke & Peetz, and by the Röchlingsche Eisen- und Stahlwerke A-G., at Völklingen in Germany. The key to the whole situation was the modification of the burden of the blast furnace in such a manner that the slags formed were of low melting point. It was well known that slags of high lime together with high alumina content have high melting points, with consequent difficulties of operation. These slags of low melting point may have a lower capacity for carrying sulphur than high lime slags of common practice, and in the manufacture of basic pig-iron it is, in general, essential that the liquid iron shall be desulphurised after tapping the metal from the blast furnace.

The desulphurisation of pig-iron is carried out in several different ways, among them being:—(*a*) By the use of a limey slag in the blast furnace; (*b*) by manganese additions to the blast-furnace burden, and (*c*) by treatment with sodium carbonate in a ladle, after the iron is tapped from the furnace.

Methods (*a*) and (*b*) have certain limitations both from the operational and the economic points of view, whereas (*c*) is capable of application to a very wide range of pig-irons.



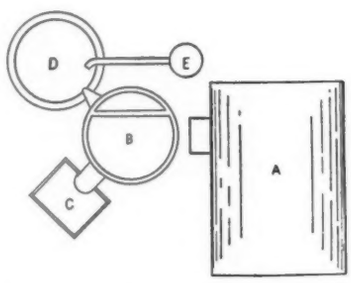


FIG. 1.—DESULPHURISATION OF MIXER METAL MADE BY THE "O.M." PROCESS.

A—Mixer from which molten iron runs into—
B—A syphon ladle of 15 tons capacity, lined with loam, and having a firebrick bottom. This separates the metal from mixer slag.
C—A slag trough into which the mixer slag overflows.
D—Is the ladle which receives clean metal from B and, at the same time, a charge of sodium carbonate from the hopper E.

Continental Work

The sodium-carbonate desulphurising process is not new, but it has only been widely developed commercially during the past ten or twelve years as a result of research work carried out in Great Britain. The method afterwards quickly found favour in Luxemburg, France, Belgium and Germany, until in 1938-39 the consumption of sodium carbonate for metal refining in these countries was at the rate of 80,000 to 100,000 tons per annum, representing the treatment of something like 6,000,000 tons of iron.

The first major Continental development employing sodium-carbonate treatment was the "O.M." (*ohne mangan* or manganese-free) process, *i.e.*, the manufacture of pig-iron without additions of manganese ore to the blast-furnace burden. The reason for this was probably mainly economic. Manganese had to be imported, and, particularly in Germany where the doctrine of economic self-sufficiency was being pushed to the limit, there was a strong inducement to use as little of it as possible. In addition, there were certain technical reasons which favoured the "O.M." process. Manganese is less easily reduced than iron in the blast furnace, and a considerable proportion of the amount charged with the burden is lost in the slag.

In order to minimise the proportion of the manganese oxide which is thus lost, additional limestone has to be used. Further, the reduction of manganese oxides can only be completed in the bosh of the blast furnace by solid carbon, and, as a result of these two factors, the coke consumption is increased proportionately to the percentage of manganese oxide in the burden. This in turn reduces the rate of output and increases the liability to scaffolding in the furnace and the production of falling slags. Manganese oxide is also said to render the slag less suitable for cement manufacture, as it impairs the hydraulic properties[1] of the cement.

The Minette ores native to Northern France, Luxemburg and Belgium contain sufficient manganese to give a maximum of about 0.7 per cent. of manganese in the pig-iron made from them. This is regarded as the upper limit for irons within the "O.M." range. Often, much less manganese than 0.7 per cent. is present. This compares with 1.2 to 1.6 per cent. of manganese which was formerly considered desirable in basic iron. An important function of added manganese is to remove sulphur from the iron in the form of manganese sulphide. This method of desulphurisation has been replaced, in the "O.M." process, by sodium-carbonate treatment.

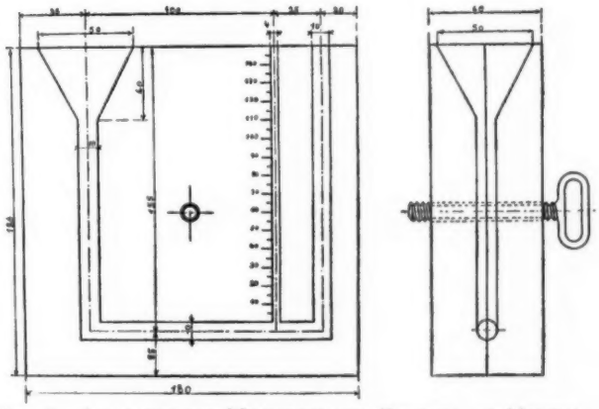


FIG. 2.—APPARATUS FOR MEASURING THE FLUIDITY OF MOLTEN CAST IRON.

Luxemburg Experiments

In a series of experiments carried out at a works in Luxemburg, the addition of manganese ore to the blast-furnace burden was progressively lowered, as shown in Table I. The furnace, which was making basic iron, was operated with a slag having a basicity ratio $CaO : SiO_2 = 1.45 : 1$. Each successive diminution of manganese in the burden caused a corresponding increase in the sulphur content of the iron.

The iron was desulphurised in a ladle by treatment with sodium carbonate. This reagent was put into the bottom of the ladle, and the iron was tapped on to it, special precautions being taken to prevent any siliceous slag becoming mixed with the soda slag. The treatment was carried out after the iron left the mixer A (Fig. 1) from which it was poured into a ladle B.

* Based on a Paper presented to the East Anglian Section of the Institute of British Foundrymen, Mr. H. H. Shepherd presiding.

The sodium carbonate was run from the hopper E into ladle D, and before the iron reached this it was passed through the ladle B, which was of the "teapot" type and effected a separation of the metal from any slag coming from the mixer. The teapot ladle had a capacity of 15 tons, and had a rammed acid lining with a bottom made of silica-alumina firebricks. Two spouts were provided, one about two-thirds of the way up, for clean metal to overflow into ladle D, and the other slightly higher, for running off the soda

TABLE I.—*Influence of Manganese Additions to Blast-Furnace Burdens.*

Manganese metal added to the burden. Lbs. per ton of iron.	Analysis of iron.			
	Si. Per cent.	Mn. Per cent.	S. Per cent.	P. Per cent.
48.5	—	—	—	—
33.0	0.43	1.00	0.063	1.77
22.0	0.44	0.62	0.075	1.80
22.0	0.47	0.62	0.073	1.82
17.5	0.52	0.57	0.080	1.86
17.5	0.46	0.52	0.097	1.84
11.0	0.46	0.45	0.100	1.84
0	0.54	0.34	0.080	1.84
0	0.55	0.26	0.082	1.79

slag into the slag pan C. The ladle D, in which the sodium-carbonate treatment was carried out, was deslagged by tilting it and allowing the fluid soda slag to run away, assisted by a rabble. The iron was then taken to the basic-Bessemer converter to be blown to steel.

An Improved Product

The consumption of sodium carbonate was about 11 lbs. per ton of iron. One part of anthracite was mixed with five parts of sodium carbonate, it being claimed that this minimised the amount of iron passing into the slag. The average decrease in the sulphur content of the metal was 38 per cent., *i.e.*, from 0.08 per cent. to rather less than 0.05 per cent., a further reduction taking place in the basic converter. At the end of the dephosphorisation stage in the converter, the residual manganese in the iron was 0.08 per cent., as compared with 0.20 per cent. when the blast furnace was operated with manganese additions. The usual manganese additions were made to the steel after blowing. Steel made by this process, of an extra soft quality for wire manufacture, was found to give very good results in the manufacturing operation. An improvement was also noted in the ductility of sheet steel (as measured by the Erichsen test) when made from "O.M." iron desulphurised with sodium carbonate. Theisen[4] reported fewer rolling-mill rejects after adopting the desulphurisation process, and the "O.M." method of operation effected a considerable reduction in costs.

It has been demonstrated that sodium-carbonate treatment of basic-Bessemer cast iron improves its temperature and fluidity. At a French works, where sodium carbonate has been used for a very long period, the monthly average analysis of the iron after treatment was as follows:—

	Per cent.
Silicon	0.30
Manganese	0.90
Phosphorus	1.80
Sulphur	0.03

The following temperatures, which are uncorrected readings with an optical pyrometer, are averages of observations taken over a very long period.

Untreated iron at the mixer spout ..	1,240 deg. C.
„ „ entering the basic-Bessemer converter	1,210 deg. C.
Treated iron entering the converter ..	1,230 deg. C.

The higher temperature of the treated metal is not unexpected, and confirms experience in this country in the treatment of foundry iron. Desulphurisation itself is probably an endothermic reaction, but it is usually accompanied by a slight desiliconising reaction which is exothermic, and more than counterbalances the loss of heat in desulphurisation.

An Interesting Fluidity Test

Fluidity tests, which are regularly carried out at these works, offer a striking confirmation of these results, and prove that, other conditions remaining constant, treated iron is much more fluid than untreated.

The gauge used for measuring fluidity is illustrated in Fig. 2. It consists of a cast-iron mould in two parts screwed together, comprising a U tube of 10 mm. dia. with a tun-dish on the top of one limb. A third limb, 4 mm. in dia., is graduated in millimetres along its length. The molten metal under test is poured into the tun-dish until it reaches the top of the other 10-mm. limb. The distance of the flow along the 4-mm. limb before solidification takes place is a measure of fluidity of the metal under test. Results over a period of a month are as follow:—

	Height of 4-mm. limb.
Undesulphurised metal at the mixer spout	55 to 65 mm.
Desulphurised metal before going to converter	85 to 95 mm.

An important practical effect attributed to this greater fluidity is that desulphurised iron can be blown in the basic Bessemer in three to five minutes less than untreated iron.

Desulphurisation is in some cases carried out in ladles with a basic lining of dolomite. These have a longer life (800 to 1,000 heats) than silica-alumina firebrick linings (400 to 600 heats). When not in use they are kept hot over burners using blast-furnace gas. Preliminary tests carried out by the author suggest that the use of a basic lining may sometimes result in a desiliconising reaction greater than that occurring in an acid lining, and this may have accentuated the temperature rise and the improved fluidity noted in the French tests. This aspect is to be the subject of further investigation.

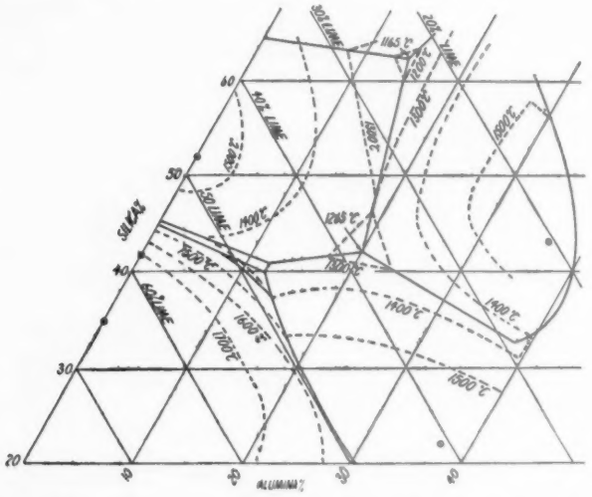


FIG. 3.—TERNARY DIAGRAM OF SYSTEM CaO-SiO_2-Al_2O_3. (RANKIN AND WRIGHT, AMERICAN JOURNAL OF SCIENCE, 1915, VOL. 49, P. 40.)

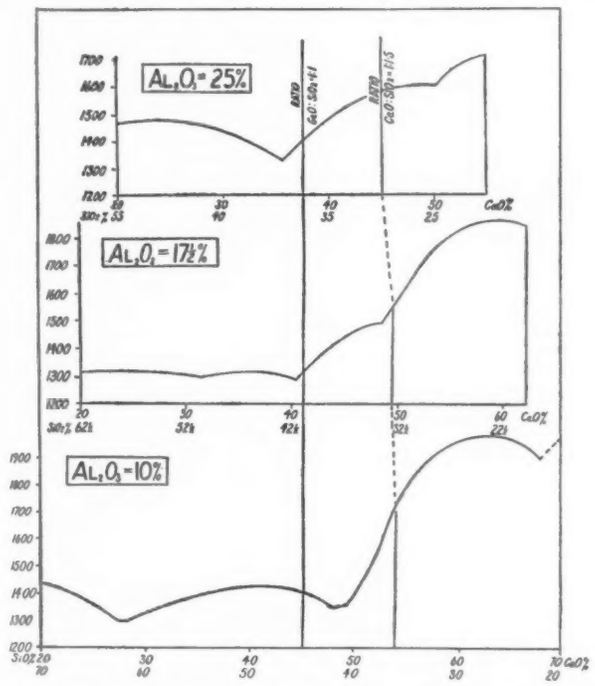


FIG. 4.—SECTIONS OF THE TERNARY SYSTEM CaO-SiO_2-Al_2O_3 SHOWING THE MELTING POINTS OF MIXTURES CONTAINING 10, 17½ AND 25 PER CENT. OF Al_2O_3.

German Experiments

Many of the ores used in France and Luxemburg are of a calcareous nature, and have proved suitable for processing by the "O.M." method without further modification to the blast-furnace burden. In Germany, however, the pre-war drive for economic self-sufficiency, involving the use of the lean native Dogger ores as well as the omission of manganese ore from the burden, necessitated still further modifications. In 1936 Germany produced only slightly more than a quarter of her total requirements of iron ore. The subsequent developments have aimed at increasing the use of native ores. A typical analysis of the native German Dogger ore is as follows[5]:—

	Per cent.
Iron	20.0
Phosphorus	0.42
Manganese	0.20
Sulphur	0.45
Silica	19.6
Lime	11.5
Magnesia	1.9
Alumina	7.5

The difficulties involved in smelting ore of this composition by conventional blast-furnace methods are obvious. Not only is the iron content very low, but the gangue of the ore is excessively rich in silica. To obtain a slag with a normal basicity ratio of $CaO:SiO_2 = 1.5:1$ would involve the addition of such a large proportion of limestone that the rate of output of the blast furnace would be severely restricted and the coke rate would soar to a hopelessly uneconomic figure.

This difficulty was tackled along lines which had been highly successful in the develpoment of Northamptonshire ore in this country, but taking into account the conditions peculiar to the composition of the German ore. A representative analysis of certain types of Northamptonshire ore is as follows:—

	Per cent.
Iron	29.8
Phosphorus	0.55
Manganese	0.2
Sulphur	0.4
Silica	7.9
Lime	6.4
Magnesia	1.0
Alumina	5.6

Advantages of Northamptonshire Ore

When this ore is smelted with practically no additions of limestone, the resulting slag contains 33 per cent. of both lime and silica, *i.e.*, these two oxides are present in the ratio of 1:1. This ratio has definite advantages from the point of view of furnace operation as compared with the more usual ratio of lime:silica = 1.5:1. These advantages are best illustrated by reference to the ternary diagram of the relevant part of the system $CaO-SiO_2-Al_2O_3$ (Fig. 3). Usually these three oxides constitute about 90 per cent. or more of any blast-furnace slag. The ternary diagram indicates the melting points of the series of oxide mixtures. In Fig. 4, three cross-sections of the diagram are shown, representing slags containing 10 per cent., 17.5 per cent. and 25 per cent. of alumina respectively. It will be seen that the lowest melting-point slags in all cases are very near to the composition coinciding with a basicity ratio $CaO:SiO_2 = 1:1$, this ratio coinciding approximately with the eutectic of gehlenite and anorthite or gehlenite and wollastonite. There is a sharp rise from these melting points to those of slags having a basicity ratio 1.5:1. The slags of low melting point have also a low viscosity at the working temperature, and as a result their sulphur-carrying capacity is reasonably high. The capacity of a slag for carrying sulphur depends not only on its composition, but on the degree of superheat which it possesses. The omission of limestone from the burden enables an increased rate of output to be obtained from the furnace, with the minimum coke consumption per ton of iron, because the limestone is replaced by iron ore. The application of these principles in conjunction with the sodium-carbonate desulphurising process in Northamptonshire and elsewhere in Great Britain has been attended with considerable success.

In Germany, however, the problem was more difficult on account of the high silica content and low iron content of the Dogger ore. The ratio $CaO:SiO_2$ in the ore itself is about 0.6:1. Lennings,[2] who describes the early experiments using varying proportions up to 100 per cent. of this and other native German ores, added sufficient limestone to bring the basicity ratio to 0.83:1. He later replaced some of the limestone by dolomite to raise the magnesia content of the slag from 2.3 per cent. to 4.5 per cent., thus improving its fluidity. The coke consumption per ton of pig-iron was 3,820 lbs., the slag weight 5,600 lbs. per ton of pig-iron, and the output 304 tons of pig-iron per 24 hrs. The hot-blast temperature was 825 deg. C. The average sulphur content of the iron on tapping was 0.448 per cent., and this was reduced to 0.082 per cent. at the mixer entry by treatment with a mixture of sodium carbonate and limestone in the proportion of 52.5 lbs. of sodium carbonate and 31 lbs. of limestone chippings per ton of pig-iron. This is a very heavy consumption of sodium carbonate, and Lennings was criticised in that connection by Holschuh,[3] who had operated the acid burden process at Völklingen, desulphurising with molten sodium carbonate. British practice is to use a mixture of sodium carbonate, limestone and fluorspar, which has proved to be more efficient.

It is recognised that if the acid burden process is to be operated economically with native ores in Germany, some method of beneficiation of the low-grade ores before smelting will be essential. Lennings considered that his best results were obtained with a ratio of lime:silica = 0.75:1. Although the slag volume might be further reduced by using less limestone, several disadvantages outweigh this. The viscosity of the slag increases as it becomes more siliceous, and so does its iron oxide content and the iron lost as pellets in the slag ("shoddy"). A minimum magnesia content of 4 per cent. in the slag is recommended to give the necessary fluidity.

In Table II is given a comparison of slag and metal analyses in British and German applications of acid burdening.

TABLE II.—*Slag and Metal Analyses in British and German Applications of Acid Burdening.*

	Northamptonshire ores.[5]		German Dogger ores.[2]	
	Normal practice.	Acid practice.	Normal practice.	Acid practice.
	Per cent.	Per cent.		Per cent.
*Slag composition**				
SiO_2	30.9	33.6		44.1
Al_2O_3	22.1	26.0		15.1
CaO	40.0	35.7		36.3
MgO	7.0	4.7		4.6
Ratio $CaO:SiO_2$	1.29	1.06		0.83
Iron analysis—				
Si	0.55	0.6	No	1.58
S	0.05	0.13	figures	0.448
P	1.85	2.00	avail-	1.95
Mn	1.42	1.4	able.	0.18
	Lbs.	Lbs.		Lbs.
Limestone per ton of iron	1,120	50		1,610
Coke per ton of iron	2,875	2,425		3,950
	Per cent.	Per cent.		Per cent.
Sulphur in slag	1.42	1.80		0.69

* The four main constituents calculated to 100 per cent.

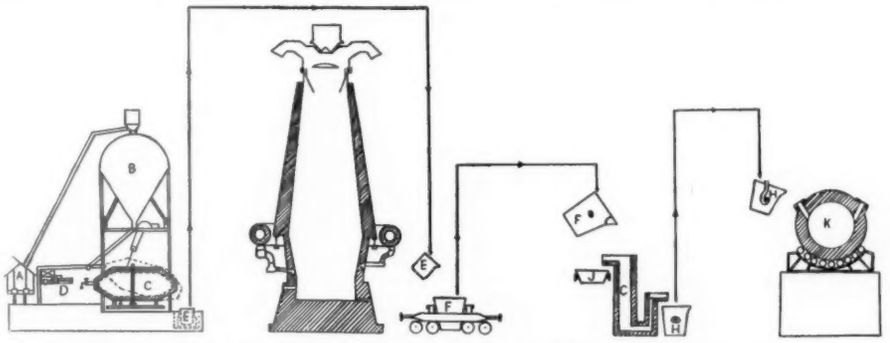


FIG. 5.—DESULPHURISATION OF CAST IRON WITH MOLTEN SODIUM CARBONATE.

A—Covered wagon for bulk delivery of sodium carbonate.
B—Silo for storing sodium carbonate, filled from A by pneumatic power.
C—Rotary furnace lined with tar/dolomite; charged with sodium carbonate by means of the worm conveyor D.
E—Ladle made of steel plate, unlined; preheated, and used for conveying molten sodium carbonate to the blast furnace.
F—The hot-metal ladle, into which molten iron and molten sodium carbonate are poured at the same time.
G—Tall syphon ladle lined with tar/dolomite for separating metal from soda slag. Slag-free metal runs into the ladle H, and is conveyed to the mixer K. Soda slag overflows into the slag pan J.

The Völklingen Process

The author visited Völklingen in 1938 and saw the acid burden process in operation at the Röchlingsche Eisen- und Stahlwerke A.-G. At that time this works was not smelting 100 per cent. of lean ores, but used a mixture, of which the Dogger ore was dried and calcined to give an iron content of 25 per cent. The basicity ratio $CaO:SiO_2$ in the blast-furnace slag was 1.22:1. With this comparatively limey slag the sulphur content of the iron was usually no more than 0.12 per cent. at the taphole. This was an early stage in the intended transition to 100 per cent. Dogger ore. Anticipating that when the final stage was reached, very high sulphur irons might be made (1 per cent. sulphur was even envisaged), an interesting modification of the sodium-carbonate process was introduced, *viz.*, the use of molten sodium carbonate, mentioned above.

The sodium carbonate (see Fig. 5)[7] was delivered to the works in bulk wagons and was unloaded by pneumatic power which carried it along a pipe to a silo. From the silo it was fed through a worm conveyor into a rotary furnace lined with a mixture of dolomite and tar, and fired with coke-oven gas. In this furnace the sodium carbonate was melted, and, when required for use, it was tapped into an unlined ladle which had been preheated internally by means of a coke-oven gas burner projecting downwards from a lid. The lid was only in position while the ladle was empty. When filled with molten soda, the ladle was carried along on a monorail and the soda poured through a tun-dish into the stream of iron in the blast-furnace runner and thence into the hot-metal ladle, which was lined with firebrick containing 32 per cent. of alumina, and which had a capacity of 25 tons. By the use of molten sodium carbonate in the proportion of 1 per cent. of the weight of metal, the sul-

phur content of the iron was reduced to 0.4 per cent., *i.e.*, 66⅔ per cent. of the sulphur was removed. An iron containing 0.18 per cent. sulphur had this reduced to 0.06 per cent. by treating with 1.2 per cent. of sodium carbonate. Holschuh claimed to get from 20 to 25 per cent. more desulphurisation with molten sodium carbonate than with the solid form.[3]

The iron ladles were transported to the steel plant, and there the soda slag was separated from the metal by pouring through a teapot ladle into another ladle in which it was carried to a mixer. The teapot ladle was lined with a mixture of tar and dolomite similar to that used for lining the soda melting furnace. At the time of the author's visit the lining had been used for some 12,000 tons of iron, and it was subsequently stated[1] that its life was 20,000 tons per lining. A feature of the ladle is its tall shape, giving it an unusual depth. This is in order to prevent small traces of soda slag passing right through the teapot spout, and also to allow the iron to be poured through a deep layer of sodium-carbonate slag. This depth of soda slag remaining in the larger limb of the ladle gives a greater degree of desulphurisation than would otherwise be obtained. The ladle is never emptied during the life of a lining, so it is kept continuously hot, as is necessary for the dolomite lining.

In Germany a use has been found for the waste soda slag. It is crushed and mixed with Florida phosphate rock and the mixture is melted in a horizontal retort heated by coke-oven gas to a temperature of 1,200 deg. C. The molten mixture is granulated by running it into water, and, after being ground, it is used as a fertiliser. It has a P_2O_5 content of 20 per cent., of which 96 to 98 per cent. is soluble in citric acid. Being a double phosphate of lime and soda, it has not the same acidifying action on the soil as has superphosphate.

Among other details which have been the subject of investigation in Germany in relation to the acid burden process, is the utilisation of acid blast-furnace slag. This problem is not so easy to deal with there as it is in Northamptonshire, where, by applying well-known and tried principles, the acid slag provides a high-class roadmaking material. The more siliceous slag produced from the German Dogger ores has a tendency to be glassy rather than stoney. By suitable mixing and other treatment it has been utilised for cement manufacture and for brickmaking.[4]

In Great Britain, the use of sodium carbonate as a desulphurising reagent has been established for some years. It has been used extensively in basic iron manufacture, but its application to other grades of iron has been limited by the fact that hot-metal ladles have not been extensively employed. Instead, the metal has been run from the blast furnace on to a sand pig-bed. This state of affairs is now being rectified on a wide scale by a growing appreciation of the advantages of hot-metal ladles and pig-casting machines. In the production of foundry irons, the uniformity of composition throughout a cast of metal as a result of the whole having been well mixed in a ladle, and its freedom from sand when it is cast in chill moulds, are both points of great value in the scientific conduct of foundries, which must ultimately replace the "rule-of-thumb" methods still used in some cases.

Application of the "O.M." Process

The use of the "O.M." process in this country raises certain more controversial problems. Its value in relation to basic Bessemer practice may be taken as proved, but there are differing views as to the need or otherwise for a certain minimum residual manganese content at the end of the steelmaking operation in the basic open-hearth process. It seems at least possible that under present conditions it may become desirable to reduce the manganese content of the pig-iron to some extent even if manganese ore is not entirely omitted from the burden. In such an event the best use would be made of such manganese as was present in the burden, and the sulphur content of the metal could be controlled with certainty by sodium-carbonate treatment.

Desulphurisation has another important application as a result of the revival of the "Armstrong Whitworth" process for the production of high-carbon iron from remelted scrap as a substitute for pig-iron in the manufacture of steel. In the manufacture of high-grade alloy steels, scrap nickel-chrome or other alloy steel is remelted in a basic open-hearth furnace together with carbonaceous matter. The resultant high-carbon steel is cast into ingots and remelted in the acid open-hearth furnace. On tapping from the basic furnace, desulphurisation may be desirable and may justify a considerable expenditure on reagents, etc. It is well known that the desulphurisation of low-sulphur iron is more difficult than that of irons of moderate or high sulphur content. The use of basic-lined ladles such as have been employed on the Continent offers great possibilities. The efficiency of sodium carbonate as a desulphurising reagent is impaired when it is contaminated by silica. Invariably such contamination occurs when an acid-lined vessel is used or when siliceous furnace slag is allowed to enter the ladle. A normal soda slag contains up to 35 per cent. of silica. The author is at present investigating the use of ladles with a tar/dolomite lining, and has succeeded in reducing the silica content of the soda slag, with a resulting marked improvement in the degree of desulphurisation of the iron.

The acid burden process originated in Great Britain and has become a well-established practice. The urgent need for increasing the consumption of home-produced ores at the present time should act as a spur to its still wider adoption. Much of the ore which is being made available is of the high alumina type, which has been successfully smelted by the acid process for years and cannot be used easily for making basic iron by any other process.

Because of the very limited amount of limestone needed for acid smelting, the maximum rate of output is obtained from the blast furnace with a minimum coke rate. Under very favourable conditions, phenomenal increases in production rates have been obtained, and in the average case, an increase of the order of 10 per cent. may be expected. This factor would be of inestimable value in helping to remedy any potential shortage of foundry pig-iron.

As regards hematite iron manufacture, it is customary to operate blast furnaces with a lime content of 50 per cent. or more in the slag in order to ensure a low sulphur content in the iron. Such a slag has a high melting point, and it would appear to be worth exploring the possibility of making a small reduction in the limestone charge. This would reduce the melting point of the slag and make for smoother operation of the furnace and the elimination of scaffolding. The rate of output would be favourably affected, and any slight increase in the sulphur content of the iron could be effectively corrected by sodium-carbonate treatment, which has the additional advantage of freeing the metal from unreduced oxides and other undesirable non-metallic inclusions.

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Careless Venting of Cores

BY W. GUDGEON.

An example of the wrong method of venting cores resulting in the loss of much time and money is described in this article. The moulding of the casting, known as an air-box, is comparatively simple, success being mainly dependent on careful venting of the core.

The dimensions of the casting are 5 ft. by 1 ft. 6 in. by 5 in., with uniform thickness of metal. A small outlet is cast on the side as shown, the round core for this being made separate and joined to the body core afterwards. The core when set in the mould is what is known as the submerged type, *i.e.*, either all or nearly all of it is enveloped by the iron. It is in this design of casting that, if cores are not well vented, air-locks are liable to occur at the time of pouring, and should this happen the molten iron is violently erupted from the mould or a gentle heaving of the iron is visible in the runner and riser. The result in each case is the same as a rejected casting.

Two of these castings were made, and both of them were scrapped through faulty venting of the core. It will be noticed from Fig. 1 that at one end of the casting the core cuts through. This should allow sufficient area for the rapid escape of air as the mould fills with metal, if

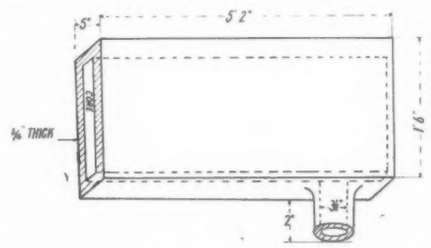


FIG. 1.

the core is provided with unobstructed air passages. As this condition did not obtain with the cores in the case of the two defective castings, the molten iron was thrown out of the mould and, in pouring the second one, a slight agitation of the metal was observed as it came up through the riser, the agitation continuing until the molten iron solidified.

In breaking one of the cores which had been dried ready for use, the cause of the blowing was revealed. A few ashes had been scattered here and there in the centre of the core, and the opinion voiced by the coremaker when he was questioned was that the natural venting properties of the oil sand in combination with the few ashes he had haphazardly introduced was all that was necessary.

When making the next four cores a layer of ashes, closely packed, was spread on top and in between the spaces of the core iron to the depth of 1½ in. and 2 in. from the sides and end, the ashes showing at the open end of the core. The ashes were then covered with sand and rammed tight, the latter operation being well attended to. With this correct method of venting, no further trouble was experienced.

Desulphurisation of Pig-iron

According to K. M. TIGERSCHIOLD, Brit. Patent 523,605, pig-iron may be desulphurised by mixing the molten iron with a slag containing CaO and/or sodium carbonate or potassium carbonate, with or without a flux, using an alternating current of 33 c.p.s. Desulphurisation is effected in a reaction chamber lined with material of low silicon content and basic or neutral to the slag, such as magnesite or dolomite.

Melting Furnaces for Grey Iron

I.B.F. SUB-COMMITTEE REPORT DISCUSSED AT BRADFORD

The December meeting of the West Riding of Yorkshire Branch of the Institute of British Foundrymen, held at Bradford, was devoted to a discussion on the Report of the Institute's Melting Furnaces Sub-Committee on "Melting Furnaces for Grey Cast Iron." Mr. H. A. MacColl, B.Sc., presided. The discussion was opened by Mr. F. K. Neath, B.Sc., a member of the Melting Furnaces Sub-Committee and Past-President of the West Riding Branch.

MR. NEATH gave an informal but comprehensive review of the Report, summarising the Committee's findings and analysing the nature of the research undertaken and the aims of the method of presenting results from the various types of furnaces dealt with. Mr. Neath embellished his remarks by relating some experiences of his own and his conclusions and commentaries thereon.

Electric Furnace Practice

MR. H. FORREST felt the meeting was indebted to Mr. Neath for a racy and helpful *résumé* of the Report. In regard to the rocking type of furnace, the object of the movement was to allow the charge to absorb some of the heat from the lining and also to induce better mixing. Electric furnaces, where power was reasonably cheap, and particularly where there was a call for special products, were very good; but it would involve high cost to install them to compete with the cupola. If ironfounders would treat the cupola with the same close attention and care as were bestowed upon the electric furnace, they would doubtless get better results.

Boshed Cupola Wells

The BRANCH-PRESIDENT (Mr. MacColl) said he noticed that the Report, in discussing the cupola lining, made reference to the boshed form and suggested it was more efficient than the parallel lining; yet later the Report suggested that either might be used. Why should it do this if one was definitely more efficient than the other?

MR. NEATH replied that it was chiefly a matter of the type of work going through. There was much to be said for boshing. It concentrated the melting zone. The coke and pig-iron were disappearing and there was nothing running into the hearth but liquid. It avoided jamming by the scrap. There had been much discussion on the matter and the Committee had not reached final conclusions.

Rotary Furnace Costs

MR. J. BLAKISTON said he must disagree heartily with the statement as to costs of the rotary furnace. The figures were too low and would be nearer the true state if 15 per cent. were added. The largest saving was in the utilisation of borings. The short form of rotary furnace was better for borings owing to the zone of combustion being central in the furnace. In the speaker's opinion pulverised fuel was a most disagreeable material to have inside the foundry buildings, and if one must have it, he suggested it should be housed separately. The Report was highly interesting and comprehensive and he was certain it should be very valuable to the Institute and the industry.

Melting Borings

MR. NEATH thought that in the electric furnace borings were handled better than in the rotary furnace. He had seen borings packed in canisters forming 25 per cent. of a cupola charge with success. In some American practice borings were used in very high proportion, and it seemed a pity that the British could not utilise more of the borings. He considered that to be a very important point.

MR. FORREST said he was a little impressed by the Report's reference to crucibles, mentioning 60 heats. That seemed to him a very high number for grey iron. His own view was that a figure of 35 to 40 was more general.

MR. NEATH pointed out that not many ironfoundries used crucibles, and the "life" figure was a very useful piece of information from Mr. Forrest.

Heterogeneity of Crucible Metal

MR. FORREST said another point worth attention was that the creosote fuel oil now being used was much more destructive to furnace linings. A large amount of carbon, deposited on the surface of the lining, might cause a good deal of abrasion. Another matter, which perhaps did not bear directly on the Report, but which had relation to the crucible furnace, was the need for care in securing an effective mixing when making additions to a crucible charge. Mr. Forrest gave details of an experience of his own in adding copper, which seemed to segregate. Anybody making additions to a crucible charge should make very sure the added material was well mixed in. Due to the shape of the pot it was not always easy to ensure that with certainty. Illustrating his argument, Mr. Forrest gave on the blackboard the following figures of results when he had added copper: 0.69; 0.58; 0.74; 0.35; 0.61; 0.61; 0.79; 0.67; 0.72; 0.65; 0.52; 0.42; 0.49; 0.74; and 0.59 per cent. These, he said, were taken out of a 350-lb. charge; fifteen samples were taken as each casting was made, and these were consecutive figures. The most startling one was 0.15 per cent. and others were 1.01, 0.76, 0.56 and 0.54 per cent.

The PRESIDENT asked what length of time elapsed between the taking of the samples.

MR. FORREST said that roughly they were taken at about three minute intervals at about 1,420 deg. C. The object in giving the figures was to give a warning of what might occur in crucible practice.

MR. BLAKISTON pointed out that little was known about mixing and stirring metal even when the furnace was rocked. The mere action of rotating the furnace would not necessarily mix the material. With a hot ladle, and receiving the metal straight from the furnace, a good mixing was probable.

MR. NEATH spoke of visiting an exhibition in Germany in which much more effective mixing was stated to be secured by a furnace on an inclined plane instead of an even rocking axis.

MR. FORREST said to his mind the high-frequency furnace did give a satisfactory mixing, in spite of the fact that some people had looked rather contemptuously on it.

Losses in Rotary Furnace Practice

MR. NEATH said he was informed that very high melting losses were encountered in the rotary furnace, and, in personal experience, the metal picked up a certain amount of silicon and some carbon; but he had little or no difficulty about the mixing. There was a stage at which the mixing became very hot and tended to lose fluidity.

MR. BLAKISTON confirmed Mr. Neath's remarks on melting loss, and said he had never been able to determine exactly where it went.

Hot-Blast Cupolas

The BRANCH-PRESIDENT said one feature of the Report was that in some parts it was very definite in its statements, but when it came to the question of the hot-blast cupola it was rather non-committal.

MR. NEATH pointed out that there had not been much data available in this country on hot-blast cupolas apart from the example of the Schürrman type, which was not a great success; and American practice, on which there was published material, was beyond the Committee's experience.

MR. BLAKISTON said this was rather strange, because the hot-blast cupola was really a very old practice in some areas. He quoted some former experience of his own in the North-East, where he operated a hot-blast stove.

MR. FORREST supported Mr. Neath's remarks as to practice in Germany, and recalled that in visiting some foundries there he asked one cupola-man about his charge; he had replied that, although it was true they used 7 per cent. of furnace coke, if they wanted a hot iron they used 10 per cent.

Object of the Report

MR. J. STOTT felt a Report of this character should be framed so as to be a useful guide to the young employee initially. The age of electricity had arrived, but the chief handicap was the cost of power; much work, in his opinion, could be done far better with an electric furnace. The composition of material was constant, and if the moulds were ready there was a far better degree of control with electricity. The rising generation was not necessarily wise in following the older practice. Reports of research committees, Mr. Stott felt, sometimes tended to be rather over the heads of the younger men and might give a false idea of practice instead of being a guide, as they should be.

MR. NEATH hoped the Report under discussion would be much used as a guide, as Mr. Stott suggested. It had to be remembered, however, that there were not very many proprietary makes of furnace on the market, and it was not politic to set out certain furnaces by name in such a Report. He agreed with Mr. Stott upon the value of the electric furnace in many ways, but it must not be forgotten that in many of the foundry's processes there must be continuous melting. There must be a certain period after melting to allow for mixing and for superheating. If one could get an electric furnace that would act as a reservoir it would be very useful; but the defect of the electric furnace at present was that owing to the arc, the source of heat was cut off during casting.

MR. A. W. WALKER, proposing a vote of thanks to Mr. Neath for his opening of the discussion, said the members had had the subject considered from many angles, which he felt was a very valuable feature. Mr. Walker approved of Mr. Stott's ideal that any report on research should aim to be a guide for the men of the industry's future, and thus benefit the whole industry.

MR. H. BALM seconded.

MR. NEATH, replying, said the Committee's aim and hope were that the Report should be of use to the students as well as to the senior members in the Institute.

Indian Iron and Steel Company

The Indian Iron & Steel Company, Limited, announce the following details of production for the period July to September, 1940:—Pig-iron, 161,468 tons; coke, 152,751 tons; heavy-iron castings, 17,021 tons; light-iron castings, 501 tons. Shipments of pig-iron from works during the period totalled 231,643 tons, while shipments of heavy-iron castings were 17,793 tons, and of light-iron castings 646 tons. All furnaces at Hirapur and Kulti are working to capacity. Furnaces Nos. 4 and 5 were put into blast in August, as, also, was the ancillary coke plant.

The Foundryman and the Metallurgist*

By F. DUNLEAVY

General Observations

In opening a discussion of this character, it is impossible to cover more than a fraction of the problems that occur in the foundry, and if this Paper appears to boost up the metallurgist, it is not with that intention that it is given. It is simply a statement of fact that accuracy, instead of guesswork or even experience, must always be to the advantage of the foundry, because, in being accurate, results are recorded regularly and become a sure indication of progress or otherwise.

The metallurgist has been trained to be accurate, so foundrymen are just taking advantage of his special qualifications in an effort to bring the foundry up to the same standard as any other department in the engineering industry. It is a personal opinion that foundrymen have remained the "stick-in-the-muds" of the trade for long enough. It is not claimed that efforts have resulted in perfection, by the elimination of all wasters, but it is hoped to show what can be accomplished by co-operation and common sense.

The first point—and the main one of this effort—is to produce a good, sound casting, machined and tested. That is the one objective of all foundrymen's efforts. The foundryman

FIG. 1.—SHOWING VARIATION OF FRACTURE WITH CONSTANT ANALYSIS.

has shouldered the blame for years past for troubles that he should never have accepted. They were not his troubles; they arose from causes which he could never hope to control alone. Some of these troubles will be explained later in the Paper.

The metallurgist has brought a scientific, or in other words, a common-sense application of records to the engineering trade that makes the difference between progression and retrogression, and it seems to be a tragedy to realise that there is still a certain type of foundryman who regards him with suspicion, because after all the metallurgist is the man whose business it is to assist him in shortening those bad patches when everything goes wrong, and after a period automatically rights itself.

The much-maligned chemist very often can and will straighten things out and tell foundrymen why and when things started to go wrong, and why it righted itself and how. The answer warns them against similar mistakes, and it is submitted that if a modern foundry can afford scrap castings, it can also afford a metallurgist.

The author has often asked the following questions:—

(1) Why cannot the foundry be managed with the same apparent certainty as the machine or fitting shops?

(2) Why was it, when perhaps one of the most important of the new foundry plants was being demonstrated, that the plant was being managed by the chemist?

(3) Why is it that, when the machine shop asks for new plant, it can have machines valued at several hundred pounds without fuss, but when the foundry requires one valued from £30 to £50, the very question would be sufficient cause for an inquest immediately?

Fortunately those conditions do not apply in the author's foundry, but it is thought that they are still far too common in the foundry world. It is suggested that the position as it existed some years ago in foundries in general, when the foundry manager or foreman would manage the foundry on a basis of his own knowledge and secrets of a lifetime, is gone for ever, and that the secrets of a lifetime are, after all, not very great secrets when exposed under the microscope, in test tubes or in beakers.

There is nothing known that some one else cannot find out, and probably the reason for it too, and that is more to the point. The author is not in any way belittling the efforts of the older school of thought among the foundry executives. They did a very fine job of work, but unfortunately they took the blame for happenings that were never their concern. The foundryman has been expected to solve a great many problems for which he was inadequately trained, and of which he possibly had little or no knowledge. Costing and estimating are but two instances.

Foundry Practice

A few years ago the author had what may be supposed is a common experience to the foundryman. It was his job to find the correct mixture and make castings in cast iron—to use the words of a works director—"Iron as soft as cheese or that kind of iron one can cut with a knife." Consequently contact was established with the pig-iron suppliers for the furnishing of the analyses of their products. A quantity of 4 per cent. silicon pig-iron was ordered so as to get 3 per cent. at the spout, yet the iron was much too hard after several attempts. As the firm did not employ a metallurgist, two pieces of pig-iron and a sample of the resultant mixtures were despatched for analysis. The results supplied the explanation. The pig-iron contained 2.75 per cent. silicon, and the castings 1.8 per cent. When the foundry received what was ordered, the castings were satisfactory.

It is hoped that no one will question the author's judgment if he cannot pick out the different grades of pig-iron by their fracture. He does suggest that with maximum experience no one can state that a pig carries a certain percentage of silicon or any other metalloid from the appearance of the fracture.

Fig. 1 shows three samples of pig-iron which are to all intents and purposes three distinctly different grades, but they carry the same silicon percentage. The same point of view is applicable to the non-ferrous metals and alloys. Having a guess is harmless provided it stops at the guess, and it must not be put forward as would be the chemical analysis of the same material. That is a point that must be stressed. Moreover the foundryman who is in the position of receiving accurate information on the metals and alloys he is using has a definite advantage over those in the much less fortunate position of having to guess at the composition of those materials.

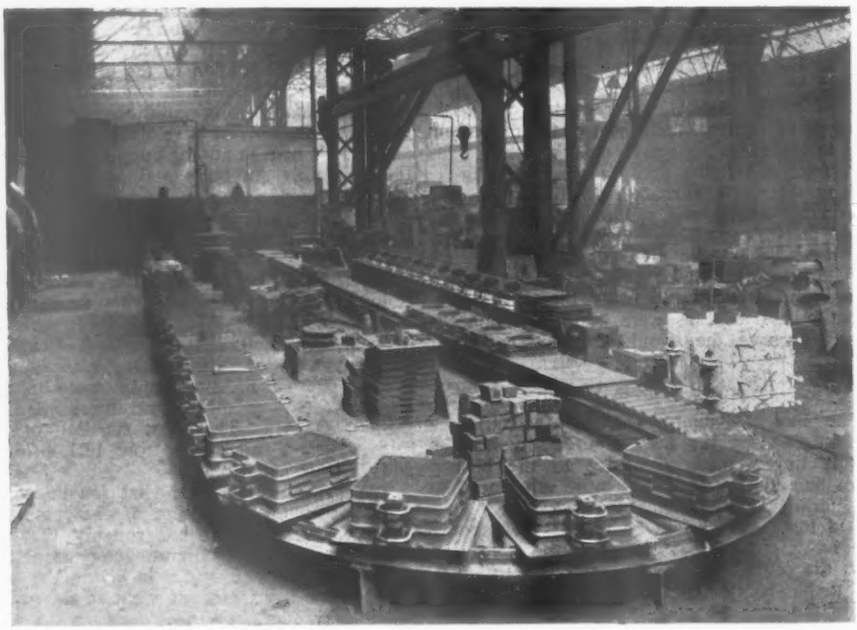


FIG. 2.—LAYOUT FOR THE ECONOMIC HANDLING OF MOULDS AND BOXES.

Cupola Practice

The production of sound castings is the sole purpose of the foundryman's efforts, and those who have had the experience of hearing some foundry problems discussed could probably describe instances similar to the following. In order to get the proper atmosphere, the reader should imagine himself in the foundry in any afternoon around the time the first tap should be coming out. The metal seems dull. The cupola man will invariably supply the following reason—the coke is "hopeless," and there has not been any hot iron since it was delivered.

The following day the coke bed is inspected and found to be the required height, so a complaint is forwarded to the coke company. Their answer is that the coke is just the same as they have supplied for years, and of the same analysis. The foundry staff take a

* Paper presented to the Lancashire Branch of the Institute of British Foundrymen, Mr. W. Holland presiding.

different view, and threaten to change the source of supply if the state of affairs is not altered.

The representative of the coke company may follow up his reply to the complaint with a personal visit, and is promptly challenged to prove his case by explaining away the cause of the dull iron. Of course, he cannot prove it; he probably knows nothing at all of foundry work, and so the meeting ends with a deadlock, with both parties promising to see what each can do for the other. What is the result? Can the promise be kept? Of course, it cannot.

Yet it seems strange that after a few days the iron is back to normal; it is hot iron, and in the eyes of many people the foundry foreman was really brilliant. The trouble has been overcome. The foreman believes that the cupola man has worked the oracle, but he does not mention it again because it may be one of his secrets. The cupola man thinks that the foreman has outstanding merit, because since he had the meeting with the representative of the coke company, they are now sending the old quality and everything has been all right since then.

A few months ago, in the author's foundry, there was the peculiar experience of the first 2 or 3 tons coming down the cupola spout very hot, but with the next few charges the temperature dropped rapidly from 1,350 deg. C. to 1,270 and as low as 1,250 deg. On investigation the cupola gang avowed that they were doing precisely what they had always done, and that their practice was the same as on the previous day and as for years past. The result was that the metallurgist lent one of his staff to check up the fault, and the result was interesting.

The coke bed was measured and found to be the correct height, after which the first four charges of iron and the three corresponding charges of coke were charged as usual, except that a record was kept of the weights, and the three coke charges were found to be varying between 14 and 30 lbs. light in weight.

The following coke charges were brought up to the correct weight and the iron tapped from the spout resulted in the first two taps being quite hot, the third tap of dull iron, and after this the temperature picked up again and the day was finished tapping at 1,360 deg. C.

The operator responsible for charging the coke thought and said that he could tell the weight in the barrow to half an ounce. The results proved that he could not, so it was insisted that he revert to weighing each barrow load. If an alternative to weighing is required, the barrows must be made to a standard cubic capacity and filled to the same height every time. This method is probably not as accurate as weighing. One precaution must not be forgotten: if the coke is wet the weight requires adjusting a little—a procedure that can be proved by some very simple experiments.

On another occasion it was noticed that the foundry always had iron of a very unsatisfactory temperature after running three 1-ton charges of steel through the cupola when making refined iron. The practice was as follows:—Three charges of steel of 1 ton each were charged into the cupola and poured into pig before the ordinary work for the day, and every time this occurred, dull iron was experienced for the rest of the day.

The matter was mentioned to the metallurgist, who pointed out that the 3 tons of steel would absorb into itself one barrowful of coke, with an inevitable low bed, which resulted in dull iron. This has been proved many times since, that an extra barrowful of coke will restore the bed and eliminate the unhappy experience of pouring iron of a border-line temperature into good moulds instead of pouring down into pig.

All this brings the subject to a rather sharp point, that the cupolamen have, to a very large extent, been accustomed to having their own way, and that attitude has probably resulted from the fact that they are in a world of their own all the morning, and when attention is drawn to the cupola, the metal is ready for tapping.

These are the conditions to which the metallurgist has to bring his pencil and paper, for eventually tables are produced and the onus of responsibility passes to where it belongs. Again, instead of the cupolaman keeping his knowledge and experience as a personal secret, and the fortunes of the foundry in his hands, he is given instructions in the same manner as one would give a moulder or coremaker.

Furnacemen or cupola-tenters have for years had responsibilities that they should never have shouldered. The author has actually heard one foundry manager say "that one should not say too much to a furnaceman because he could so soon let one down." That is a position that is intolerable to both parties.

As a case in point, consider the position by the old method, when 20 tons of grey iron were required. The 20 tons could be composed of 9 tons of hard cylinder mixture, 8 tons of cylinder mixture and 3 tons of ordinary iron. Occasionally, what happened was that the first eight or nine charges were placed into the charging hole, when the question was asked, "Is that the eighth or ninth?" One man would say eight and another nine, so they put in another "for luck." Thus an attempt was made in the author's foundry to eliminate as much of the uncertainty as possible. He again appealed to the metallurgist to come with his pencil and paper, and the following was the result carried out on a cupola of 6 to 6½ tons per hr. capacity.

The coke bed was to be 27 in. above tuyeres, and a wrought-iron rod was provided to test the height of the bed. Approximately 16 cwts. or seven barrow-loads of coke are required to give this correct height. It was found practicable to measure the coke for the bed, rather than weigh, because of the very irregular shape and size of the coke. Having reached this stage, the blast is put on for 3 to 5 min., and just prior to the first charge of iron, one more barrowful of coke is added to cover the mushy top of the bed. This practice ensures a hot bed, and prevents the first iron from being dull.

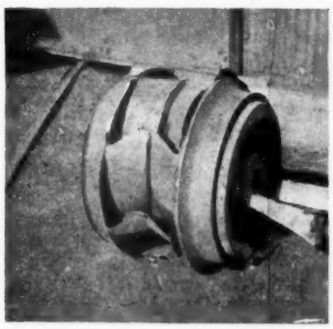
Between 10 and 15 min. after the blast has been put on, the iron is beginning to melt, and from this time the men can tap 6 tons in the first hour, after which the rate increases to 6½ tons per hour. Moreover, whatever tonnage be required, it can, and is, calculated in order to drop the cupola bottom within quite a narrow margin of time. To make the charging as foolproof as possible, a chart is hung up on the cupola stage showing the quality and quantity of the various materials to be used. A board is also hung up, squared off for each charge and various mixtures, and one of the foundry staff, whose duty it is, marks with chalk a stroke for each charge, and the man responsible cancels the stroke every time another charge is completed. The man at the tapping hole also has a copy of the quantity of the iron charged into the cupola.

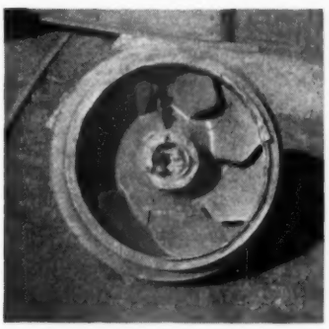
To complete the whole job, the problems that remained to be settled were to get the iron away from the cupola spout rapidly enough, and to have the ladles under the spout again for the next tap without being compelled to shut off the blast. This difficulty has very largely been overcome, and the management can invariably tell a moulder when his iron will be ready. He will then know how long he has to finish his moulds.

Foundry Sands

The term "foundry sand" means a great deal more than the words convey. More labour hours are spent in sand handling and working than in any other material in the foundry. Dietert records that in a particular foundry producing 100 tons of castings per day, the labour cost of sand handling and working was 22 times that of the metal preparation and handling. The only means the foundryman had of testing his sand was to take a handful and squeeze it, saying to himself—"That is just right" or "It is too wet," by noticing whether the sand retained its shape after the hand squeeze. Again, the feel of the sand would tell him whether there was sufficient bond in the material or otherwise.

Then came the work on foundry sands by Dietert, Hudson, Sheehan, Skerl and other men who are still searching for and giving information on a very troublesome question. Foundrymen should be able to try out their recommendations in their own laboratories for the guidance of their staff.





FIGS. 3 AND 4.—A TYPE OF IMPELLER DIFFICULT TO CAST IN MONEL METAL.

Even with the modern speedy means of taking moisture tests, it is suggested that the tendency is to do this for a few weeks, perhaps fairly regularly each day. Then comes the time when the foundry staff have all their work cut out for a few days, and the job is left undone, perhaps for weeks, until fettlers begin to raise that still, small voice, and the scrap begins to accumulate. The foundry executive begins an investigation and promptly recommences the moisture tests with the same inevitable results as before. The sand is restored to standard moisture, and that snag disappears.

A well-equipped laboratory can take care of all these problems by checking the sand properties, so maintaining the standard of quality. It is suggested that any foundryman who uses oil sand for his cores has had trouble, and serious enough too, at some time or other. To quote one or two instances, all foundrymen are familiar with the appearance of a fairly heavy, complicated casting with its oil-sand core knocked out, showing a scoured surface due mainly to incorrectly mixed sand or a lack of baking, or again damping back after being held in stock, and failing to dry the cores sufficiently before placing into the mould.

The author believes that the industry is even

yet only on the fringe of the oil-sand problem in the foundry, and this opens out a very wide field for future work in following up the work already done by the numerous experts, together with personal experience. Perhaps the most important fact is that when these experiments are recorded by the laboratory staff the foundrymen get a detailed record of all that has been done. That is a job for which the foundryman has neither the time nor the training.

Non-Ferrous Practice

Fig. 2 shows a view of a simple method for handling machine-moulding boxes and casting them whilst on a roller conveyor. There is no attempt to make 100 per cent. use of this plant in the competitive sense. It was laid down for one job only, a job with a large number off in the non-ferrous foundry, and subsequent results certainly justified its introduction.

The output of the plant was about 10 boxes per hour from one machine, and the weight of metal per box varied from 20 to 40 lbs. These variations in numbers and weights raised the first of the difficulties—that of arranging the melting output to match the mould production, and so to avoid becoming either box-fast or track-fast.

This sounds simple and elementary; yet it is but fair to point out that this problem was raised and faced during its first few days, in fact, immediately after running in the first moulding machine. As any delay on the metal side actively concerned the metallurgist, he was called in to assist. Exhaustive time study was organised over a period of days, and from the conclusions drawn, the respective demands of metal and moulds were completely satisfied. Each variable was attacked with a stop watch, and detailed notes taken of:—(1) Time per half-mould; (2) finishing, coring and closing; (3) changing pattern plates, which normally occurred several times daily; (4) determination of the lag between casting and knocking out, so that the machine moulder would have sufficient boxes to carry on until the jobs already cast were knocked out; (5) core-shop practice (this had to be so arranged that cores should be ready to be drawn on when required by the shop; on this point, not only the semi-mechanised unit, but the whole foundry, was compelled to follow a system of ordering cores in advance, and careful timing ensured the cores against damping back through being ordered too far in advance); (6) weight of each casting or box of castings, plus allowance for runners and risers, etc., so estimating in advance the amount of metal required at any time during the day.

The accurate records of the metallurgist gave the foundry something to work on, and when the plant started production, and the inevitable foundry problems arose, they were faced from the same point of view. It was proved that if the facing sand became too strong, scabs would result on certain types of castings, and if the facing sand was too weak, sprigs were needed. If the backing sand was too wet, the moulds would tend to blow, and so on.

Regular moisture tests were taken, and are still carried out. Six per cent. moisture in facing sand and 7 per cent. in the backing sand were found to be admirable for the purpose. The strength of the backing sand increased, due to the fact that the sections of the castings were not heavy enough to burn the clay in the facing sand, so that the sand heap is carefully controlled, and usually two or three barrowfuls are taken away each week into the foundry and replaced with the equivalent of black floor sand.

The semi-mechanised system has proved successful mainly because of the application of science or common sense, and the making and keeping of accurate and systematic records during the running-in of the plant.

Whilst still dealing with problems in the non-ferrous foundry, it is suggested that conditions are becoming very much more complicated as time goes on, and the inevitable result means closer control than ever before, to ensure that the castings will pass all their pressure tests and that the test-bar results will satisfy the inspection.

Figs. 3 and 4 illustrate a type of impeller that will cause a great deal of trouble when made in Monel metal unless great care is taken in foundry practice, involving very close control of the final chemical composition. There are several difficulties in producing sound Monel metal castings. The sulphur must be kept as low as possible, and very small amounts of lead will ruin the metal, by the fact that it causes hot-shortness. As little as 0.08 per cent. lead in the final analysis will lead to the castings cracking in cooling. The silicon content must be controlled, and the carbon must be kept below 0.05 per cent., as excess of either will cause brittleness. Apart from final composition, melting, moulding and running all require special attention if good castings are to be produced.

In reviewing the complications and the difficulties in making sound castings in Monel metal, the author has reached the conclusion that the foundryman who attempts the problem without metallurgical assistance is worthy of a decoration awarded for conspicuous gallantry in the face of overwhelming odds. Moreover, such a decoration would be awarded posthumously.

Casting Temperatures

"Casting temperature" is a term used far too loosely. Various authors have passed on their experiences of the maximum and minimum pouring temperatures for the various alloys, and a definite impression is given that, provided these temperatures are adhered to, there will be no more worries. Nothing can be more misleading than this belief, as it gives rise to a false sense of confidence and ignores the main problems of furnace practice—overheating and gas absorption.

Casting temperature is of minor importance if non-ferrous alloys are overheated in the furnace, as the damage has been done. If test-bars be required, the foundryman will soon learn, from the poor tensile figures and low elongation, that something has gone wrong in the process. Pressure castings also bring this point home to the non-ferrous foundryman very readily.

Experience compels the foundryman to regard the casting temperature as of secondary importance until he has gained control of his melting practice. In the author's non-ferrous foundry the main bulk of metal is melted in two oil-fired rotary furnaces, shown in Fig. 5, each of 10 to 15 cwts. capacity. Teething troubles have been experienced in control of melting practice, and experiments are now in hand to provide definite data as a guide for the furnace man.

The obvious difficulties are:—(1) Charges may vary from a few cwts. to the full capacity; (2) the composition of charges varies according to the proportion of scrap and virgin metals used; (3) eight different mixtures are in use, each with its own melting and casting temperatures, and (4) the work to be cast varies from a few lbs. to 25 cwts. Time-table and temperature records and test results are being collected, and it is expected that very valuable data will be available in the near future.

(To be continued.)

FIG. 5.—OIL-FIRED ROTARY FURNACES.

Wartime Expansion of Industry

Tax concessions are to be made to industrial undertakings laying down plant which proves to be redundant after the war. Making this announcement in the House of Commons, Sir Kingsley Wood said that next year's Budget would provide all traders with an allowance for income-tax and N.D.C. purposes in respect of buildings, plant and machinery erected for the war effort and proving redundant when peace returned. This allowance would be calculated similarly to that already permitted for E.P.T. purposes under the second Finance Act of 1939. That Act permitted 10 per cent. of the net cost of new plant to be charged against profits in any one year.

Sir Stanley Reed had asked whether, having regard to the importance of enabling industry to undertake extensions necessary for war purposes, the Chancellor of the Exchequer would consider the grant of an allowance to traders for the purposes of income-tax and National Defence Contribution in respect of the exceptional depreciation of buildings, plant and machinery which were necessary to meet the demands upon their businesses under war conditions, but would no longer be required after the war.

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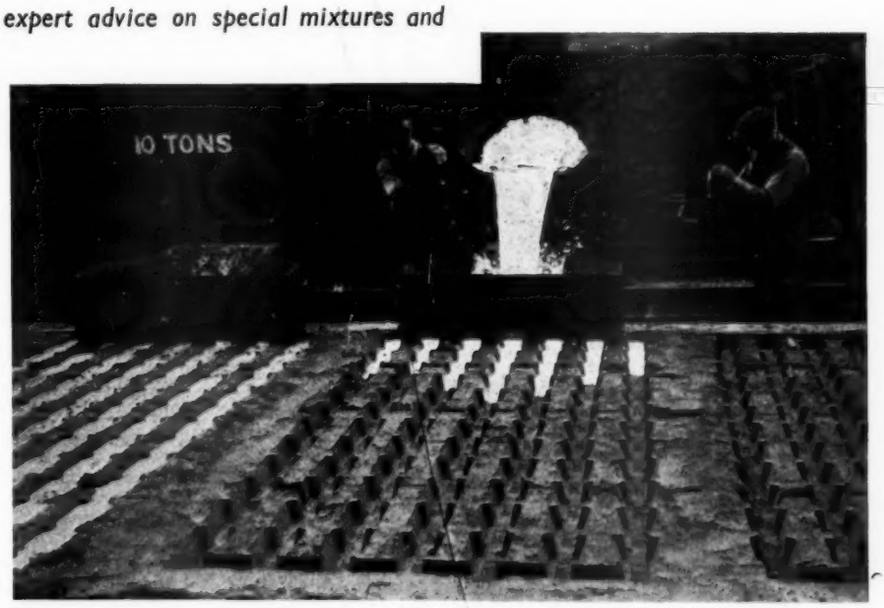
Users are invited to avail themselves of the Stanton Technical Service which offers free expert advice on special mixtures and other Foundry problems.



THE STANTON IRONWORKS COMPANY LIMITED, NEAR NOTTINGHAM

Some Jobbing Foundry Experiences—XV

By "TRAMP"

Previous examples in this series have been of small and medium-sized castings in green sand made in a small shop of limited crane capacity. The following notes deal with a different class of work made in a shop possessing a travelling crane and considerable stove room. Fig. 1 is a sketch of a typical casting. It is a fairly heavy engine flywheel required in various sizes. For repetition work a full pattern rammed on a moulding machine would be ideal, but in this

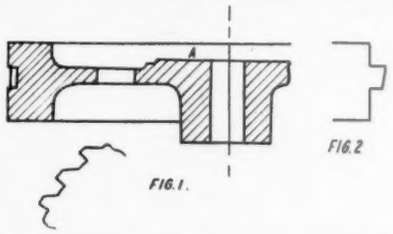


FIG. 1.

FIG. 2

instance other means have to be adopted. This example is one which readily lends itself to loam sweeping, and that is the method adopted.

Before describing the moulding details and patternwork, attention is necessarily called to the teeth around the periphery of the wheel for "barring the engine." These have to be made in a series of segmental cores, a print being swept in the course of building. This print and the cores must be made in such a way that the

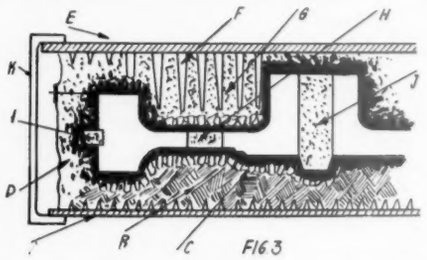


FIG 3

cores can only be assembled one way, otherwise the resultant casting may have the teeth the wrong "hand." This is obviated by sweeping the print with a definite taper, as in Fig. 2, and making the core box to suit. The coupling face A, being the most important, is cast downwards. A part section of the assembled mould is shown in Fig. 3, A being a strong foundation plate, B ashes to facilitate venting the face of

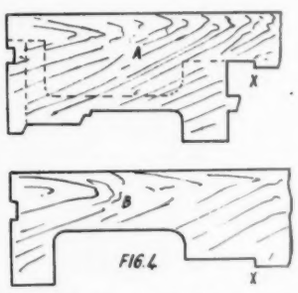


FIG. 4

the casting, C pieces of dried loam to form the bottom of the mould, and D courses of brickwork forming the outside. E is a top plate carrying the long teeth F to hold the bricks and loam work G. H indicates one of the six cores placed on the bottom and I one of the tooth cores, while J is the centre core. Clamp K is one of several used to hold the top and bottom together during casting.

Fig. 4 shows the boards necessary for sweeping such a mould. A sweeps the bottom and B the cope or cover. X in each case sweeps a definite size on the outside of the mould which is used to assemble the top in correct position by "feeling." After sweeping and drying, the mould is blackwashed and assembled. The six cores H are placed on the bottom while the centre core and the tooth cores are fixed in their respective prints. The job is run on the rim with a riser on the boss.

Diaries and Calendars

Since publishing the list of calendars and diaries which have been sent to us, several more have arrived. To the senders of these we tender our sincere thanks and reciprocate the good wishes which accompanied them.

From **Ashwell & Nesbit, Limited,** Barkby Road, Leicester—A daily tear-off wall calendar surmounted by a pencil sketch of St. Bartholomew's Gatehouse, Smithfield, by Joseph Pike.

From **Smith & Fawcett, Limited,** of Horton Works, Lidget Green, Bradford—A wall calendar carrying the whole year on stiff cardboard.

From **The Butterley Company, Limited,** Ripley, near Derby,—An illustrated monthly tear-off wall calendar, the sheets of which show the previous, the current and the next month's calendar.

From **Wright & Company,** of Clarence Street, Sydney, New South Wales—A monthly tear-off wall calendar.

From **Harris & Pearson, Limited,** Stourbridge—A monthly tear-off wall calendar mounted on cardboard carrying illustrations of standardised firebrick shapes.

EDITORIAL INDEX TO VOL. 63

The editorial index to Volume 63 of the Journal (July to December, 1940) is now ready for printing. Readers who wish to receive a copy are asked to make early application to the Publisher, 3, Amersham Road, High Wycombe, Bucks.

Lord Beaverbrook Thanks S.A. Foundry Owner

Mr. Arthur H. Moore, of the Standard Brass, Iron & Steel Foundries, Limited, who recently gave £5,000 for the purchase of a Spitfire, which he requested should be named "Benoni," has received the following letter from Lord Beaverbrook, Minister for Aircraft Production, through the office in Pretoria of the High Commission for the United Kingdom:—"Please convey to Mr. A. H. Moore, of Benoni, my warmest thanks for his magnificent contribution for the purchase of aircraft. He has strengthened the power of the Royal Air Force and brought encouragement to all connected with aircraft production. His gift is a most splendid example of the determination to do their utmost for victory which associates the peoples of our Empire to-day in every corner of the globe. The British nation is his debtor."

A Twelvemonth of Price Stability

By "ONLOOKER"

Early in December, 1939, it was decided to free tin from the control which had held the quotation at £230, and the market immediately began to rocket upwards. Copper, lead and spelter remained stable at the controlled quotations instituted when war broke out; but the serene atmosphere which ought to accompany stability in values was not there during those early months, for it was widely held that values had been fixed too low and that an upward revision would prove to be necessary. There were even those who clamoured that this was overdue and whose ideas, coloured perhaps by recollections of the fantastic price levels achieved by copper and spelter during the 1914-18 period, reached forward into the summer of 1940, when, so they averred, copper at any rate would be many pounds higher in value. The Ministry of Supply, however, kept its own counsel and no word of affirmation or denial came from this source. Rumour was rife, and perhaps because a controlled market makes but a dull background to business, the suggestions put forward were some of them outside the realm of practical politics. Consumers paid little heed to the spate of talk for they, too, had other preoccupations mainly concerned with securing the copper necessary to keep pace with the increasing tempo of production. Then on December 18, the cat, in the shape of Ministry of Supply No. 5 Order, was let out of the bag and a twelvemonth of stability was ushered in.

Current comment was to the effect that both lead and spelter had been unduly boosted by comparison with the increase in copper, and this criticism had much point. It was also noted that no official maximum was listed for blister copper, but this omission did not create much stir. Those who still retained bullish views about copper scoffed at the idea of electrolytic being held down at £62 and aired the opinion that the authorities would be compelled to bolster up supplies by recourse to American brands. The future of the United States copper mines, and of those in South America, too, was being painted in bright colours at this time, for it must be remembered that France was still a serious buyer of very large quantities and no embargo, moral or otherwise, had been laid upon export of the metal to Russia and Japan.

Even a year ago consumption of copper in this country was on a very big scale, and those who counted on supplies from the Empire falling short of requirements were right in supposing that the rate of usage would increase. Their calculations apparently did not take note of the fact that the producers in Canada and Rhodesia were straining every nerve in the execution of carefully-laid plans to expand their output.

Then with dramatic suddenness the existing state of affairs was swallowed up in a German victory over France, and from the fog of war there emerged a picture on which kaleidoscopic changes day by day made it impossible even to guess at the march of future events. Almost immediately the disappearance of our ally from the fighting line brought a repercussion on the copper situation in Britain, for cargoes on the high seas moving towards Bordeaux and other ports were diverted to U.K. harbours, and the trickle of additional tonnage, begun when Scandinavian consignments were seized, became a sizeable stream.

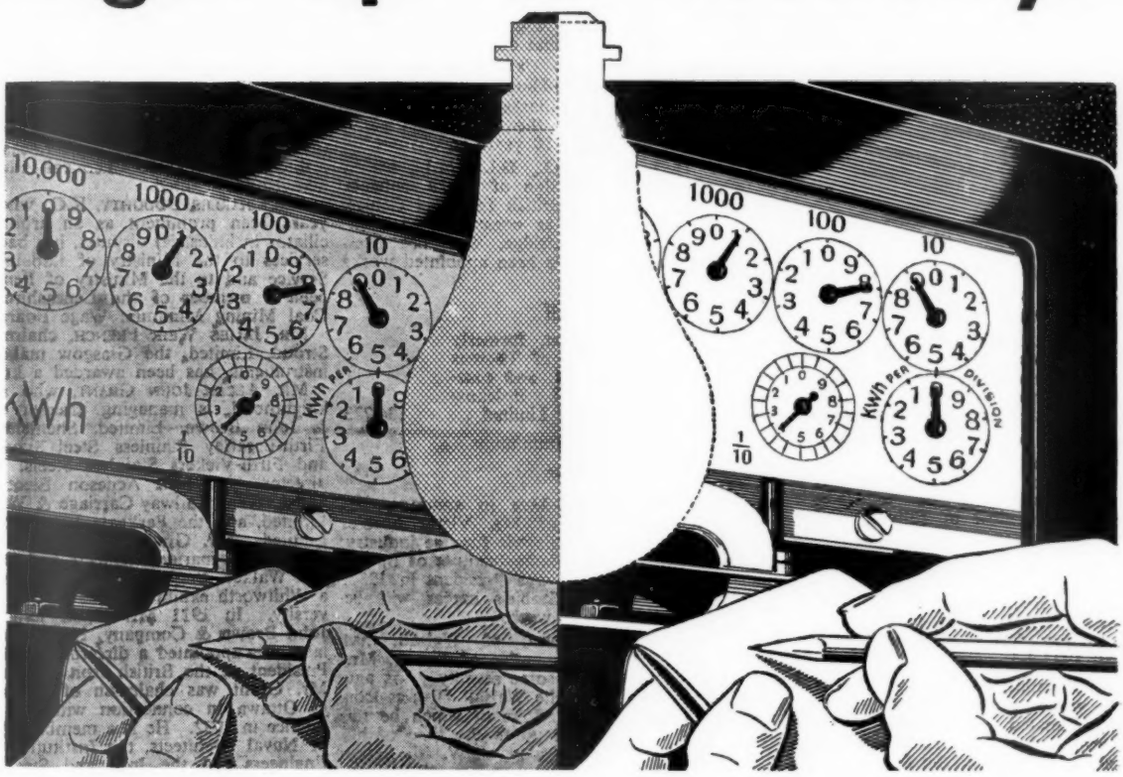
A collapse in the dollar price of copper followed and it was no longer possible to doubt that the sterling quotation could not be kept

(*Continued from next column.*)

down at £62. Now the former prophets of weal became the prophets of woe, for as in a vision they saw the quotation in New York plumbing the depths, but once again time has proved them wrong, for after breaking 10 cents the export price has picked up again and now the portents are that at 12 cents domestic copper is a good buy. It says much for the sound judgment of those controlling metals in Britain that against a background of dire events and convulsions in world affairs price stability has been maintained.

(*Continued at foot of previous column.*)

Light up—for economy!



The lighting bill is one of those necessary overheads—but one which needs watching. Especially in these days of rising costs. Remember this, though. It's not what you pay, but what you *get* for your money that counts. Fit Osram Lamps, then, and when the lights go on, you'll know you are getting your money's worth. Osram Lamps—sturdy and reliable—give you all the light you pay for—a full return in brilliant light for every unit of current consumed.

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The Week's News in Brief

Trade Talk

NITRALLOY, LIMITED, give their new address as 25, Taptonville Road, Sheffield, 10.

DURING the year the employees of the Mirrlees Watson Company, Limited (Engineering & Foundry Departments), subscribed towards infirmaries, convalescent homes, Red Cross and other institutions, a sum amounting to £627 14s. 1d.

WE REGRET that the telegraphic address of British Pigirons, Limited, was given as Ironobrit, Phone, Byfleet, instead of Ironobrit, Phone, Woking, in our issue last week. This, of course, refers to their Woking office.

CLYDE ALLOY STEEL COMPANY, LIMITED, held its first wartime social and dance in Hamilton Salon last week when about 240 members of the staff participated. Mr. and Mrs. John Craig and Mrs. M'Cance were amongst the guests.

A RECENTLY issued American Patent (No. 2,219,554) describes a process for colouring the surface of stainless by a sulphuric acid treatment. The Patentee has assigned his rights to the Allegheny Ludlam Steel Corporation of Pittsburgh.

THE TEPLOGORSKY IRON WORKS and the Goroblagodatsky Sintering Works in Russia have collaborated in the production in a charcoal furnace, from Kusinsk titano-magnetites, of naturally alloyed vanadium pig-iron, low in sulphur and phosphorus.

THE LONDON OFFICE of Alldays & Onions, Limited, foundry and general engineers, of Great Western Works, Small Heath, Birmingham, has been changed from 9, Victoria Street, to 2, Queen Anne's Gate, Westminster, S.W.1. The telephone number is Whitehall 1923-4-5.

ACCORDING to the Statistical Bulletin of the Tin Research Institute, world production of tin in November, 1940, is estimated at 21,800 long tons, compared with a revised figure of 21,000 tons for October. The total production for the first eleven months of 1940 is approximately 209,800 tons, against 156,200 tons in the corresponding period of 1939.

A CLAIM by foundry workers and engineers for a wage increase of 3d. an hour and restoration of pre-June, 1931, working conditions was heard in London on Tuesday by the National Arbitration Tribunal. Mr. J. Tanner put forward the case on behalf of the Amalgamated Engineering Union and the National Union of Foundry Workers, and the employers' reply was given by Sir Alexander Ramsay. The Tribunal's award will be made known at a later date.

THE CANTOR LECTURES to the Royal Society of Arts will this year be delivered by Mr. James G. Mann, M.A., B.Litt., F.S.A., on the subject of "The Influence of Art on Instruments of War." Mr. Mann, who is Master of the Armouries of the Tower of London, and Keeper of the Wallace Collection, will trace the close connection between the fine arts and instruments of war since early times, and will include some reference to the founders of bronze cannon. The lectures will be presented to the Society in London on January 20, 27 and February 3, at 1.45 p.m.

THE national survey undertaken by the Iron and Steel Control to bring to the furnaces all available fixed and demolition scrap is now being extended to Lancashire and Yorkshire. Somerset and Glamorgan have already been dealt with and Scotland, London and the four North of England counties are in process of survey. The Iron and Steel Control is very well satisfied with the response already made by the local authorities, and the general effect has been to expedite the flow of much available and unwanted metal to the scrap heaps. Mr. H. G. Judd, Controller of Salvage in the Ministry of Supply, in a statement reviewing the progress of the national salvage campaign, said that local authorities, though already burdened by a great deal of other war work, had salved to October 30 last, in the first year under the war-time plans, about 750,000 tons. The total proceeds from sales of material was about £1,900,000, but this figure represented only the scrap value and not its real utility value. The total included 220,000 tons of scrap metal.

Personal

MR. R. J. TUCKER, works manager of the Bryan Donkin Company, Limited, of Chesterfield, has relinquished that position. A gold watch has been presented to him by employees of the firm.

MR. AND MRS. CHARLES CLARKSON, who have celebrated their golden wedding, are well known in the Larbert area. Mr. Clarkson is 80 and was employed for 59 years by the Carron Company, Falkirk. He retired about 10 years ago.

COL. J. TENNANT, D.S.O., D.L., M.I.Mech.E., who retired from his position of works manager of the Prescot Works of British Insulated Cables, Limited, will be retained as consultant on plant matters. Mr. D. W. Aldridge, who has been assistant works manager, has been appointed works manager.

Will

BEST, F., of Bickley, Kent, formerly director and secretary of Thomas Firth & Sons, Limited, and commercial manager of Bolckow Vaughan & Company, Limited ... £34,723

Obituary

WITH DEEP REGRET we have to announce the death on December 31 of Mr. Victor Stobie, M.I.E.E., a pioneer in the electric furnace industry and a prominent member of the Institute of British Foundrymen, of which he was President in 1932. An appreciation of Mr. Stobie's career will be given in the JOURNAL next week.

MR. WILLIAM M. LESTER, of Walsall, has died at the age of 90. A native of Tipton, Mr. Lester removed to Walsall some seventy years ago to become associated with the Walsall District Iron Company, Limited, in the affairs of which he retained a very close interest up to the time of his death. He was a director also of W. M. Lester & Sons, Limited, iron and steel rollers, of Walsall.

MR. EDWARD HICKMAN, of Danescourt, Tettenhall, Wolverhampton, died on Thursday last in his 81st year. Mr. Hickman was formerly a director and afterwards chairman of directors of Alfred Hickman, Limited, Spring Vale Furnaces, Bilston, until the firm's amalgamation with Stewarts and Lloyds. When he resigned an illuminated address, together with other valuable gifts, was presented to him. He was connected with many other industrial concerns in the Midlands.

WE regret to announce the death of Mr. James Boyd Allan, a former vice-chairman and managing director of David Colville & Sons, Limited, and a director of Archibald Russell, Limited. Some 50 years ago, Mr. Allan started as testing superintendent with David Colville & Sons, at their Dalzell Works, Motherwell. In 1901, on the death of the late John Colville, M.P., he was appointed secretary of the company, and later became a director of the concern. In 1916 he was raised to the position of managing director and vice-chairman, retiring in 1931 when David Colville & Sons amalgamated with James Dunlop & Company, Limited, to become known as Colvilles, Limited.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Technaloy, Limited, Premier House, Southampton Row, London, W.C.1—Capital, £100. Ironfounders, steelmakers, refiners and rollers, etc.

J. & T. Spiers, Limited, Bovay Works, Bovay Street, London, N.17—Capital, £1,000. Electrical, chemical and general engineers, etc. Directors: J., T., D., and Z. J. R. Spiers.

Contract Open

London, E.C., January 14—Castings, etc., during the twelve months commencing April 1, for Finsbury Borough Council. The Borough Engineer, Finsbury Town Hall Annexe, Rosebery Avenue, London, E.C.1.

New Year Honours

SERVICES TO INDUSTRY

The second Honours List of the war was published on January 1. It contains the names of a number of recipients who are identified with the foundry, iron and steel, engineering and allied industries. Brief biographical details are appended.

MR. PETER FREDERICK BLAKER BENNETT, who receives a knighthood, was recently appointed Director-General of Tanks and Transport in the Ministry of Supply. A Past-President of the Federation of British Industries, Mr. Bennett is chairman of C.A.V., Limited, chairman and joint managing director of Joseph Lucas, Limited, and a director of Imperial Chemical Industries, Limited, and Rotax, Limited.

MR. CHARLES DOUGHTY, K.C., who has for many years been prominent as an arbitrator and conciliator in industrial disputes, has been knighted for services to the Ministry of Labour and National Service and to the Ministry of Pensions. He has been a member of the Lancashire and Cheshire Coal Mining Minimum Wage Board.

MR. JAMES WEIR FRENCH, chairman of Barr & Stroud, Limited, the Glasgow makers of scientific instruments, has been awarded a knighthood.

MR. ALLAN JOHN GRANT, who also receives a knighthood, is managing director of Thos. Firth & John Brown, Limited, Sheffield, chairman of Firth-Brearley Stainless Steel Syndicate, Limited, and Firth-Vickers Stainless Steels, Limited, and a director of British Acheson Electrodes, Limited, and Cravens Railway Carriage & Wagon Company, Limited, and the Parkgate Iron & Steel Company, Limited. Mr. Grant was a pupil of Laird Bros., Birkenhead, marine engineers and shipbuilders, and the Walker Engineering Laboratories. He was a Whitworth exhibitioner in 1896 at Liverpool University. In 1911 Mr. Grant joined the staff of John Brown & Company, Limited, and eight years later was appointed a director. In 1932 he became President of the British Iron and Steel Federation. Mr. Grant was chairman of the steel delegation to Ottawa in connection with the Imperial Conference in 1932. He is a member of the Institution of Naval Architects, the Institution of Mechanical Engineers and the Iron and Steel Institute. He is a former Master Cutler.

MR. SAMUEL OSBORN, LL.D., J.P., who (as reported in the Journal last week) receives a knighthood, is chairman of Samuel Osborn, Limited, the Sheffield steelfounders, and chairman of the Sheffield Juvenile Advisory Committee.

MR. GEORGE EDWIN BAILEY, who has been awarded the C.B.E., is managing director of Metropolitan-Vickers Electrical Company, Limited, and a director of Associated Electrical Industries, Limited, General Railway Signal Company, Limited, and Switchgear Testing Company, Limited.

MR. JOHN ASPINALL, who has been made M.B.E., is works director of Hick, Hargreaves & Company, Limited, Bolton.

Company Meeting

Crompton Parkinson, Limited

A record production year was reported at the annual meeting of Crompton Parkinson, Limited. MR. FRANK PARKINSON (chairman and joint managing director) said that it had been a year of ever-increasing effort to produce more and more of the machines and equipment required for the prosecution of the war. As far as possible they had directed their energies down the familiar channels of their normal range of products, believing that by so doing they could produce more and produce it more efficiently than in any other way, but the insistent demand for other manufactures had not found them unwilling to test the flexibility and versatility of their organisation in new fields. The development of the company's overseas connections and manufacturing capacity had for many years been a cardinal feature of the policy of the directors, and they had given close attention to the best means of prosecuting it both during the war and in the altered conditions which would undoubtedly follow it. In recent years there had been a marked tendency towards greater industrialisation in the Dominions, and the support now being given to this country by the production of armaments in the Dominions seemed likely to result in an acceleration of this trend. The company had made extensions to their existing factories overseas and had become partners in new factories manufacturing products within the range of the company's activities.

Acknowledgments to Manganese Bronze and Brass Co. Ltd., Woodall-Duckham Co. (1920) Ltd., and Hadfields Ltd.

The modern development of refractory materials owes much to close co-operation between manufacturer and user of refractories. As Britain's leading manufacturers, General Refractories enjoy the custom and confidence of many thousands of refractories users engaged in every branch of the metallurgical, engineering and other industries of the world. This intimate relationship is fostered by General Refractories because it provides "G.R." engineers and chemists with a real close-up picture of the actual needs of every type of user. In addition, it provides an invaluable fund of practical experience—which proves the soundest basis on which to maintain and develop a high standard of consistently uniform quality products. This method of procedure is your assurance that there is not only a "G.R." product made for your particular business—but that if you have a problem involving refractories, "G.R." data and experience will help you to find the answer. We want you to feel free to consult the "G.R." Technical Advisory Section at all times. It will enable you to tap this vast organisation for the greater efficiency of your business or plant.

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Raw Material Markets

Foundrymen continue to place orders against licences issued by the Control authorities as soon as their allotments are made known to them. Most heavy foundries, of course, come within priority categories, while more and more makers of light castings are receiving business for Government departments. Priority users are getting their needs met in full, but other consumers can be allotted only a limited tonnage of pig-iron. It is difficult to state accurately the condition of the light-castings trade, as the position varies at individual works, but, on the whole, there has been a marked improvement during the past few months. Many light foundries have widened the range of their products, and are now able to discharge Government work, while there is also more business about in connection with builders' requirements.

Pig-Iron

MIDDLESBROUGH—Consumption of foundry iron continues to expand among users in the Cleveland area, but there has been no corresponding increase in the output of local furnaces, so that the brunt of the larger demands has been placed on Derbyshire and Northamptonshire producers. Satisfactory deliveries are arriving from these districts, but existing conditions do not allow large stocks to be accumulated. The heavier consumption of high-phosphorus iron has largely been brought about by the better-filled order-books of the light-castings makers. Pressure on hematite producers continues to be insistent, and outputs are moving away as they become available. Where possible, consumers are incorporating iron produced from home ores, but there is, of course, a limit to the extent of this substitution, and recourse has to be made to foreign hematite. It is understood that the Iron and Steel Control has bought further large tonnages, which should become available for distribution in the near future.

LANCASHIRE—Ironmakers are busily employed in meeting the substantial orders of buyers in the Lancashire area, especially from the speciality engineering establishments, which are engaged mostly on Government contracts. Consumers in this county obtain their requirements from ironworks in the Midlands, and quite good deliveries are being made to consuming points. Conditions in the jobbing foundry trade have become rather quieter of late, while the situation at most light-castings foundries is still disappointing, the improvement reported during the past few weeks having been slow. Foundries' calls for hematite are being met only in part, and the position in this respect shows little indication of early change.

MIDLANDS—Light-castings makers in the Midlands are not always able to acquire licences for the purchase of their full requirements of high-phosphorus iron, although foundries engaged on work of national importance are satisfactorily placed. More non-essential orders have recently been made available to the light-castings industry, thus resulting in an expansion in the demand for high-phosphorus iron. On the whole, the trade is well placed and a fair amount of raw material is coming forward even for ordinary domestic purposes. It is not expected that there will be any deterioration in the position, as high-phosphorus iron is, of course, produced from home ores, which are plentiful. Brisk conditions continue to be reported from heavy engineering works, which have as much business on hand as they can conveniently handle for months to come, with the promise of further orders on Government account later. Low-phosphorus iron and hematite, which are largely used by these concerns, are still only available for important work, but better deliveries are being made following the importation of large tonnages from abroad. Refined irons are in good supply and many users of low-phosphorus iron and hematite are able to utilise refined grades quite freely.

SCOTLAND—All descriptions of iron are well taken up by Scottish consumers, and there has lately been additional pressure on foundry grades. Steelworks and other priority consumers are taking up large supplies, while the light-castings foundries, being better placed for orders, are consuming increased tonnages. Many of the latter took short holidays at the turn of the year, as they are not all able to operate their plant full time. Deliveries of iron from the English Midlands are delayed at times through rail congestion, but little inconvenience has been caused.

Coke

Some foundry-coke users report that supplies are coming through less freely than was the case a short time ago, but this can be attributed to traffic congestion rather than to shortage of fuel, which is, in fact, plentiful. Fortunately, buyers mostly have substantial quantities in reserve, so that they have not been handicapped as a result of delayed arrivals of fresh supplies. Foundry coke prices have been raised by 1s. per ton.

Steel

There can be little doubt that the British steel industry will be called upon to make an even bigger contribution to the nation's war effort this year. All sections of the trade are operating at full capacity, and there can be no respite, as replacement orders are available, thus ensuring a continuance of working. Ingots and semis are arriving in this country regularly from overseas, and are needed to supplement home production. The most insistent demand appears to be for light sectional material and special steel for munitions, while there has been some easing off in the call for the larger sizes of joints, channels and angles. The outcome of the census of stocks of steel at users' works is awaited, but it is unlikely that any unknown factors will be brought to light regarding the position, as the Control has always borne in mind the amount of material held in stock when making allocations.

Scrap

Business in scrap iron and steel has been brisk so far this year, with buyers anxious to cover their forward requirements. This is generally possible, as large tonnages are available and fresh material is being combed out daily. A high rate of consumption is assured, and in some directions larger supplies are being taken up. For example, many foundries are making increasing use of scrap in place of pig-iron, which is difficult to obtain in adequate quantities at times. At the same time, foundries are finding the utilisation of scrap an economic proposition. More vigorous methods are being adopted to bring out scrap material, and the results should be gratifying.

Metals

Although trading in tin in London is "free," a certain measure of control exists over the market, if not to the same extent as in the case of other non-ferrous metals. Prices and conditions generally have been steady for some time past, and there is little reason to anticipate any marked change in the early part of the new year at any rate. There is, of course, a minimum of speculative interest at the present time. Consumption both here and in the United States is expanding under the rising demands of defence contracts.

Mr. Dermot J. Mooney has been appointed to represent Nigeria on the International Tin Committee. He will fill the vacancy created by the resignation of Mr. Oliver Lyttelton, President of the Board of Trade. Mr. Mooney has been active in the Nigerian tin-mining industry for a number of years, and he was one of the founders of the Nigerian Chamber of Mines, of which he is vice-chairman. Mr. Mooney is one of the Nigerian representatives on the International Tin Research and Development Council.

The total visible supply of tin on December 31 was 39,066 tons, according to Mr. W. H. Gartsen (Henry Rogers, Sons & Company), as compared with 33,127 tons at the end of the previous month. The carry-over in the Straits Settlements was 3,472 (3,811) tons, while the carry-over at principal European smelters was 2,248 (3,073) tons.

The December issue of the Statistical Bulletin of the Tin Research Institute, which is controlled by the International Tin Research and Development Council, states that world production of tin in November last is estimated at 21,800 tons, compared with 21,000 tons in October. The total production for the first eleven months of the current year is approximately 209,800 tons, against 156,200 tons in the corresponding period of 1939. United States deliveries totalled 106,139 tons in the first eleven months of 1940, showing an increase of over 75 per cent. as compared with the deliveries of 60,530 tons in the first eleven months of 1939. The 1940 deliveries include tin acquired for the emergency reserve stock. The consumption of tin in the United Kingdom in the first ten months of 1940 was 24,904 tons, against 21,244 tons in the corresponding period of 1939. World stocks of tin, including smelters' stocks and carry-over, increased by 1,388 tons during November to 55,278 tons. Stocks at the end of November, 1939, were 50,607 tons.

Tin prices on the London Metal Exchange during the past week have been as follow:—

Cash—Thursday, £256 10s. to £256 15s.; Friday, £256 10s. to £256 15s.; Monday, £256 15s. to £257; Tuesday, £256 15s. to £257; Wednesday, £256 10s. to £257.

Three Months—Thursday, £259 15s. to £260; Friday, £259 5s. to £259 15s.; Monday, £259 15s. to £260; Tuesday, £259 15s. to £260; Wednesday, £259 15s. to £260.

Very large consignments of Empire copper are reaching United Kingdom ports, but the requirements of the war machine absorb the greater part of the supply, leaving little metal available for other than priority consumers. It is estimated that domestic production of copper in the United States will fall short of requirements during 1941 to the extent of 150,000 short tons, so it is probable that the U.S. Government will make further purchases of South American metal. Domestic production is running at an annual rate of approximately a million short tons.

The chief demand for spelter emanates from the consumers of high-grade metal, but g.o.b. metal is in good request from the galvanisers, who are in possession of large Government contracts. Supplies are forthcoming to buyers having licences to make purchases, but allocations in other directions are restricted. Lead, on the other hand, is plentiful; consumption has displayed a rising tendency of late, but users are able to acquire all they need.

Reports and Dividends

Follsain Syndicate, Limited—Accounts for 1939 show a loss of £2,171, which, it is stated, is made up of items which in the main are merely book entries and have not been paid.

Cannon Iron Foundries, Limited—Profit for the year to September 30, £2,831; brought in, £5,536; taxes, £2,660; preference dividend for three months to December 31, 1939, £1,788; carried forward, £3,919.

John Bedford & Sons, Limited—Profit for year to September 30 last, £33,295; to tax reserve, £19,807; net profit, £13,488; brought in, £4,217; preference dividend, £2,500; dividend of 10 per cent.; to reserve, £3,000; carried forward, £4,706.

Joshua Bigwood & Son, Limited—Trading profit to September 30 last, £38,079; brought in, £372; depreciation, £5,916; tax, £17,409; preference dividend for 18 months to September 30, 1940, £6,075; ordinary dividend of 10 per cent., £4,312; carried forward, £2,047.

Moss Gear Company, Limited—Net profit, after taxation, etc., for the year to August 31, £69,873; brought in, £36,029; final dividend on the ordinary shares of 12½ per cent. and a cash bonus of 5 per cent., making 22½ per cent. for the year; carried forward, £41,902.

J. Samuel White & Company, Limited—Profit for the year ended September 30, 1940, after provision for depreciation, E.P.T. and income tax, £58,185; brought in, £14,192; dividend on the preference shares, £5,145; dividend of 12½ per cent. on the ordinary shares, £20,685; to general reserve, £25,000; carried forward, £21,547.

R. A. Lister & Company, Limited—Profit for the year ended September 30 last, after making provision for depreciation, taxation and contingencies, £99,577; brought in, £75,961; preference dividend, £11,025; ordinary interim dividend of 5 per cent., £21,875; final dividend of 5 per cent. and bonus of 6 per cent., £44,275; additional pensions reserve, £2,500; to general reserve, £25,000; carried forward, £70,863.